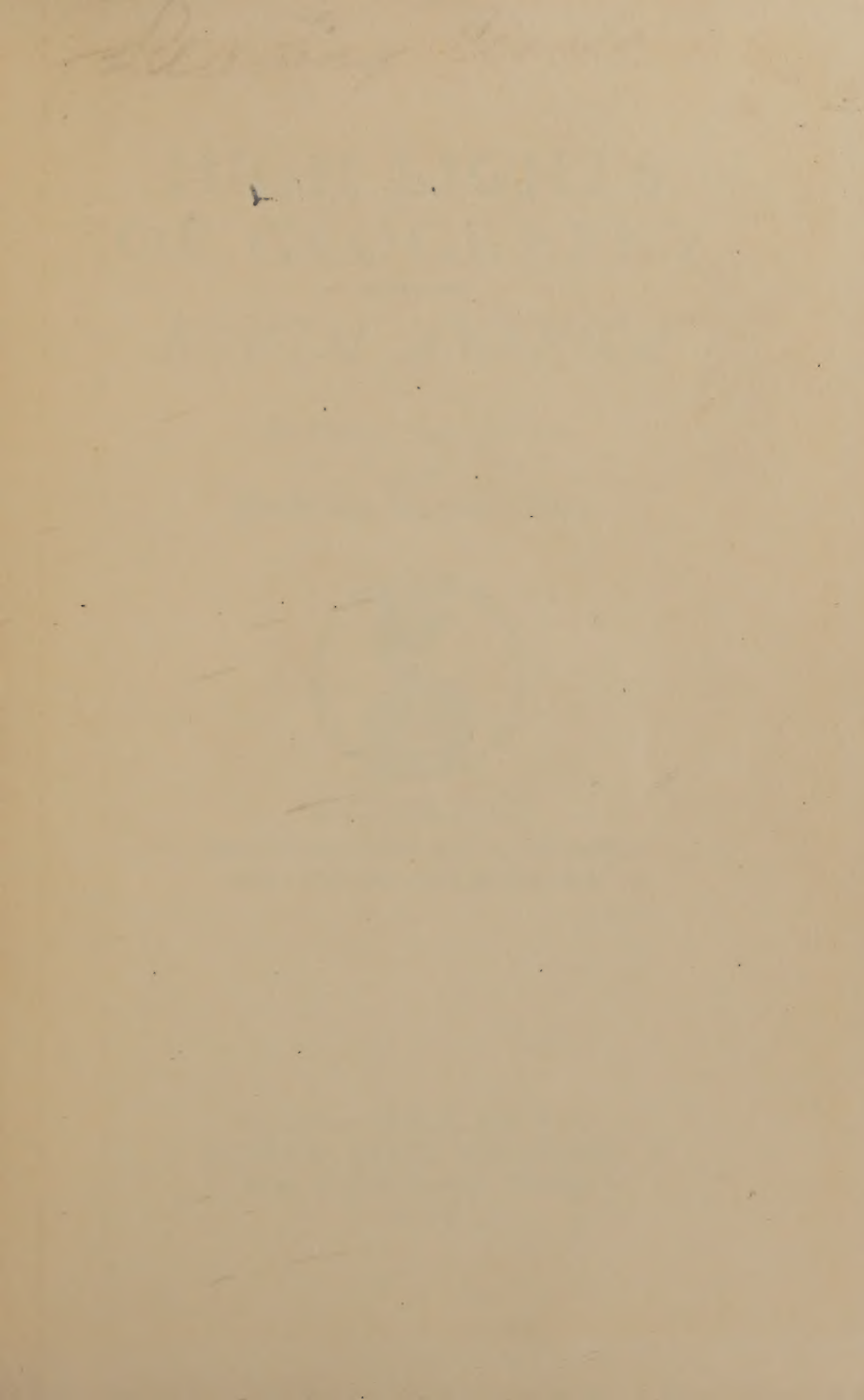




**HIGH LIGHTS OF  
GEOGRAPHY**  
***NORTH AMERICA***  
**JORDAN AND CATHER**

A. J. Glassina  
Educ. Adviser







# HIGH LIGHTS OF GEOGRAPHY

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## *NORTH AMERICA*

By David Starr Jordan  
and  
Katherine Dunlap Cather



ILLUSTRATED  
*with 11 maps and with 21 airplane  
views and 120 other photographs*

Yonkers-on-Hudson, New York  
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*High Lights of Geography* is designed to furnish to the student a background picture of this world as turned out by the hand of the Creator. The geological story is interestingly told, and the clothing of the earth with plant life and animal life is naturally unfolded. The volume on North America and the volume on Europe tell what nature has done to make a home for us, while it is left to the regular textbooks in geography to furnish the man-made features of these continents. Incidentally, the human side of geography is here and there brought into its relation with natural features. The main purpose throughout the narrative has been to supply many of those high lights not found in other elementary books, which will enliven the study of geography in school and out. The combined experiences of a great scientist, known the world over, and an unusually successful teacher, have made it possible for World Book Company to offer in this series one of its best contributions to its list of "Books that apply the world's knowledge to the world's needs"

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## FOREWORD

THIS book came into existence almost by accident — certainly by no one's deliberate intention. The senior author sat one summer evening in 1915 on the hospitable porch of "Kanyonkrag," the home of his friend and former student, Caspar W. Hodgson, at Yonkers-on-Hudson, New York. At his feet were the Hodgson children, Foresta, Daphne, and Kaspar, while across the broad river rose the long, dark, level-topped wall of the Hudson Palisades. He ventured to tell the children the story of this great sheet of lava as it appeared to him, a simple enough bit of geological science, which, however, attracted the father's notice. Being a publisher of books, both useful and picturesque, Mr. Hodgson insisted that this tale and a score of others should be told to the children of America. As all the young folks could not gather together, the stories had to be put into writing, but even this was quite impossible because the story-teller himself had many other things to do.

At last a plan was worked out. Mr. Hodgson sent to Stanford University one of the most pleasing writers for young folks, along with a clever stenographer, whereupon I related all the tales of the mountains, geysers, glaciers, lakes, and rivers of America that I could conjure up.

These Mrs. Cather faithfully put into form, and while the senior author perhaps set the pace, the junior author is responsible for details. She also embellished the records from her own studies of the folklore of the Indians, telling us from time to time what the aborigines thought of the mighty powers which hemmed them in.

The senior author is indeed mainly a medium of transmittal. Whatever of interest or charm this book may have, is due to Nature herself in the first place, and after that to the literary skill of the final recorder.

DAVID STARR JORDAN

STANFORD UNIVERSITY, CALIFORNIA





## THE PURPOSE OF "HIGH LIGHTS OF GEOGRAPHY"

THE study of the geography of the United States should do more for the boys and girls than give them the facts concerning their country. It should engender in them some conception of what God did for America before man began to utilize it. That is what the authors had in view in writing this book of a type different from the geographical readers hitherto prepared for use in the elementary schools.

*High Lights of Geography* presents to the child not only effects but causes; it presents to him the physical features of the continent upon which he lives, and makes clear how those features came to be. It feeds his desire to know about the reasons for conditions as he finds them, which is as common today as it was during the childhood of the race, when the unsatisfied longing and imagination of primitive people played around the mountains, rivers, glens, and shore lines, the sunshine and the changing seasons; and, unable to get any other explanation, they worked out the fanciful, crude ones that became the great mass of the world's myth and legend.

Broadly speaking, it is between the ages of ten and fourteen that boys and girls are most keenly curious concerning the world around them, and question most eagerly as to what made things as they are. They are not satisfied just to know that New Hampshire produces granite and Vermont marble and slate, that the rivers of New England are generally short and swift and an abundant source of water power, while those of the South flow through sandy lowlands and, except in their upper courses, are not of a type to turn factory wheels. Youth in this age of inquiry wants to know *why* it is so. And because for the most part the reasons are hidden away in volumes beyond the understanding of elementary school children, very often their questions go unanswered until interest is dulled or dead.

*High Lights of Geography* satisfies curiosity about the world at the time when it runs highest. In language a child of ten can comprehend, it presents the reasons for the physical features being as they are, shows these features in their relation to plant and animal life, and points the way to an understanding of the reasons for the distribution of industries. It opens to boys and girls gates to fields of knowledge that usually are closed until during high school and college years. It makes it possible for the pupil who does not go beyond the grammar grades to have an understanding of the world in which he lives that will heighten his enjoyment of that world.

Because children love stories and veer away from books that state bare facts, the material is presented in narrative form, the approach being an Indian legend; and throughout the chapters are scattered tales wherein are recounted the Red Man's idea of how the hills and streams came to be, contrasting the explanation of the primitive tribesman with that of his cultured white brother, who sees the shore lines and prairies with the eyes of a scientist. This method serves to illuminate the physical features and to arouse in the child the appreciation and love of nature that lies dormant in every human heart, and that, if not allowed to slumber, will send him through life with eyes that see and a spirit that responds to the appeal of the beautiful and wonderful around him. It tends also to make him more sympathetic toward those who lived upon our continent during an earlier time, and awakens in him something of an understanding of the struggle of mankind to discover truth as it groped its way toward civilization. Appreciation and love of nature, sympathetic understanding of those who knew far less than we know but were earnestly seeking, all tend to broaden the soul and enrich the nature, and contribute abundantly toward good citizenship.

*High Lights of Geography* is therefore a book to be read and



studied as a definite part of the course in geography. If it is merely placed on a shelf of the school library, many of the children will dip into it, and those with initiative and ability will be led to explore for themselves fields of knowledge to which the classroom lessons in geography point the way. But every child needs this background and this illumination of the facts of geographical knowledge, because of its power to make him a more seeing, feeling, and comprehending individual, better fitted to take his place in the world than he can be without it.

KATHERINE DUNLAP CATHER



## ACKNOWLEDGMENTS

For permission to use the poem "Trees," with which the final chapter ends, the authors are indebted to the publishers of Mr. Kilmer's poems. It is reprinted from *Trees and Other Poems* by Joyce Kilmer. Copyright, 1914, by George H. Doran Company, Publishers.

The authors wish to acknowledge also their indebtedness to those whose collections of photographs have contributed much to the concrete interest and vividness of this book. The sources of the illustrations are given here.

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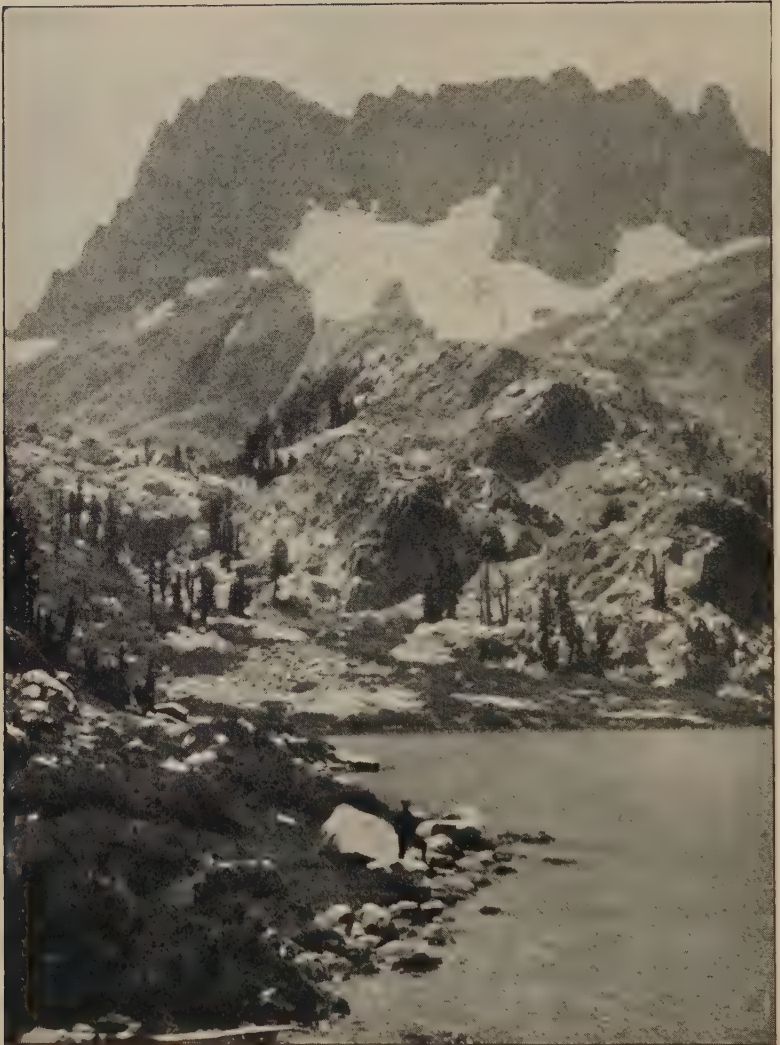
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THIS work deals primarily with objects which can be seen and the history of which can be traced. But our great world is merely a speck in a Universe which has no boundaries. In the Universe inconceivably vast, we find everywhere motion and change, and every change is orderly. We know no source of order except intelligence. Only an Infinite Intelligence can be conceived as initiating and controlling all forces and objects in Nature. Such an Intelligence without variableness or shadow of turning represents the scientist's conception of God.

PART ONE  
HOW THE EARTH WAS MADE



In the high Sierras, east of Yosemite National Park, California. "Frost-torn peaks of every height and bearing pierce the blue wastes above. Dropped here and there, gleam turquoise lakes which swell the basins where vanished glaciers did their last work."



# HIGH LIGHTS OF GEOGRAPHY NORTH AMERICA

## CHAPTER ONE

### WHENCE CAME THE WORLD

#### I. THE INDIAN'S STORY

IN the far-off days when Indians roamed all over America, when there was not a factory or schoolhouse or wagon road in this whole great country, and when the only settlements were villages of wigwams and tepees set up by the Red Men along lake shores or river banks, an Indian boy whose name was Wako went on his first trip with the hunters.

Very proudly Wako trudged along beside the braves, through the forest and up over a ridge of hills from which could be seen lakes and rivers and another forest with mountains piled beyond it like a purple wall. In all his eleven years, he had not beheld anything so vast and wonderful, and he was certain that he saw outspread before him the end of the world. He wanted to know what made the sparkling streams and how the cliffs and ridges came to be there, but the braves were no wiser about them than he was. When they went home that night, he hurried to the lodge of White Tamarack the Medicine Man, who was old and wise, and told of the splendid sights he had seen that day.

"What makes the shining waters and the big purple wall?" he asked, as he squatted beside White Tamarack at the wigwam door. "What makes the trees, and the birds that fly, and the snow that never forgets to come after leaves have fallen in the forests?"

White Tamarack did not answer for a little while. He smoked his pipe and looked with dreamy eyes toward the setting sun, for he was thinking of the time when he too

went on his first trip with the hunters, and of the story the old chief told when they got home that night. It had seemed a wonderful tale then, and he never had forgotten it. Now, with Wako beside him, and the gray of gloaming trailing like a veil between the trees, he repeated it softly, while eagerly the boy listened.

"The world is very old, my son, and this is how the rivers and mountains came to be.

"In the beginning there was nothing but water on the earth; but above the sky, in a world like this one, Coyote and Red Fox lived together in contentment. One day Coyote went out to get wood for the fire, and while he was gone Fox grew very lonely, for there was nobody to talk to and nothing to do. To amuse himself, he dug a hole through the sky with an arrowhead and looked down.

"There lay the sea, blue and rippling and more beautiful than anything he had ever seen. He thought he would like it for a home; so he climbed down, and because a fox cannot live in the waves, he dug under them and brought up enough mud to make a little island. Then, well satisfied with the new country, he stretched out and slept in the sun.

"By and by Coyote returned with his wood. He thought Red Fox must have gone to the other side of the sky house, and he waited for him to come back. But a long time passed and he did not return; so Coyote began searching for him and in that way stumbled on the arrow hole.

"‘The rascal has gone below,’ he thought to himself. ‘I will follow him and find him.’

"As Coyote climbed down through the arrow hole, he saw Red Fox on his island and went over to see what kind of place it was. He liked it and told his friend they would live there together.

"But there was not enough room for two. With both of them there, Red Fox had to lie curled up in a ball like

Wobo the Porcupine, and whenever either one turned over, they bumped noses.

"‘A house for two must be big,’ Red Fox exclaimed.

“As he spoke, he pushed the land out with his foot and extended it far to the south. Then east and west he stretched it, until the earth became as large as it is now.

“Because he did not want the sea to flow in and cover it, he piled mountains along the edge, which are those you saw today. He scooped out lakes and rivers too, heaped up other mountains in the center to keep the streams from running together, and after that he made men and animals, flowers and trees, and all the creatures that live now.”

Wako believed every word of the story, for he did not know that White Tamarack was no more wise about how North America came to be than the Indian children themselves. He did not know that, although rivers and mountains and trees are the best kind of books, chiefs and medicine men who have had neither schools nor teachers do not know how to read them. The creation story of White Tamarack was just the answer to a question like Wako's that some other Indian living long before him had thought out, not being able to imagine any other way in which the world might have been made.

Each tribe of North America had its account of the beginning of the world. Some said a medicine man had sprung from the ashes of the northern lights and made valleys and mountains out of dust and cinders. Others told that Charyea, whose name in English would be Old Man Above, pushed snow down from the clouds and filled up the sea. Still others insisted that the forests and highlands among which they lived had been put there by enchanters who came out of the world below, and that peaks arose and rivers were born while the enchanters danced and powwowed. So certain were the people of each tribe that their

own creation tale was the true one, that they considered those of other Indians very ridiculous and stupid.

Yet not one of the Indians knew why the Appalachians lift their rocky ribs from Vermont to Alabama; why the Hudson River flows into the bay of New York instead of into the Arctic Ocean or the Gulf of Mexico; or how the great Cordillera system came to stand in the western part of North America.

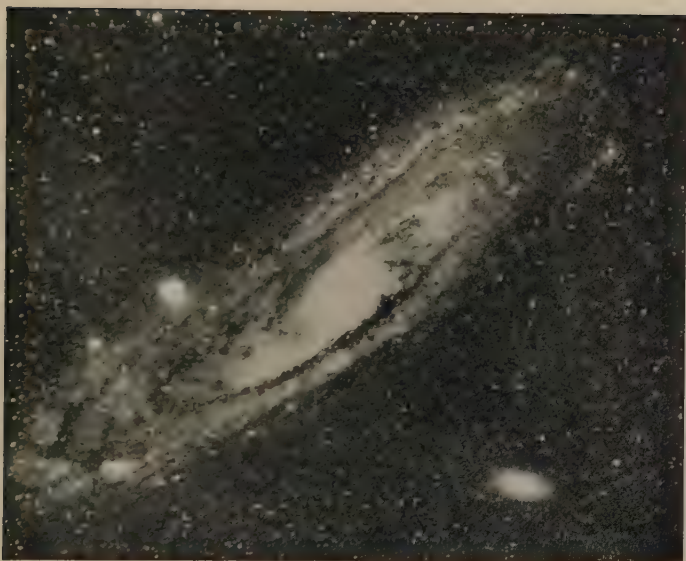
## II. THE WHITE MAN'S STORY

Nobody was here when the world was made; so of course no one has ever told from experience what happened during the creation time; but scientists who devote their lives to studying the stars, the cliffs, the ocean bed, and all the other marvels of nature, think they have found out how this old earth came to be.

Some scientists have thought that in the beginning the matter of which the sun, the earth, and all the other planets is composed was a cloud of white-hot vapor. For ages and ages this mighty fire-mist kept whirling round and round. Nobody knows what set it in motion, but many things seem to indicate that it whirled, and that, in whirling, it threw off masses of matter, just as water is thrown from a swiftly revolving grindstone. According to this theory our earth was one of these thrown-off portions from the sun, just as the moon was a thrown-off portion of the earth. In some way the portion that is now the earth solidified and hardened and became the planet we know.

This theory was worked out by a French astronomer named Laplace. He gave it a wise-sounding name, the Nebular Hypothesis. It was a fairly reasonable explanation of the origin of the earth, and for a great many years people accepted it.

Recently, however, some scientists have found objections to the theory that our world had its beginning in a



A cloudlike mass, called a spiral nebula, as seen through a powerful telescope. Planets formed in a nebula, such as this one, have been supposed to have been the beginning of the earth, Mars, and other planets that we see today.

revolving cloud of hot vapor. A majority of them look favorably on the theory advanced by an American geologist, Thomas C. Chamberlin, and called by him the Planetesimal Hypothesis.

Dr. Chamberlin imagines that two great shining stars once came close together as they were moving rapidly through the heavens. One of these was the great body that we know as the sun. We must think of them as having the power to attract the material around them just as a magnet does. The sun was partially broken up by the power of attraction of the other star, and the material pulled away from the sun went on whirling rapidly in the form of white-hot gas or vapor. It is hard to imagine a solid body becoming gas, but even iron can be turned into fiery gas if it becomes hot enough. Here and there in the rapidly whirling vapor



were fragments of solid matter. These solid bits attracted the material around them, picking it up as a magnet picks up scraps of iron, or sweeping it up as their paths crossed. Thus they increased in size until in time they became the earth, the moon, and various other bodies that are moving about the sun through space.

According to this theory the earth began, not as shrinking hot vapor, but as a small nucleus which has grown through additions on its surface, and which has shrunk and folded through compression and the expulsion of water and air. We must think of the seas as driven out from within the earth by heat and pressure. This we are not sure of, however, and so we call it a working hypothesis or theory, to be discarded, as many others have been, whenever it ceases to work; that is, whenever the facts we find out cannot be made to fit into it.

We know that the earth is very old, too old to be measured in years. Different scientists have advanced different theories as to its age, but we have not sufficient facts to be certain that any of the theories is correct. The highest estimate is about 1,600,000,000 years that the earth, as a revolving sphere with a hard crust, has been moving about the sun. The lowest recent estimate is 40,000,000 years.

We have no certainty as to where the supposed fragments came from. We do not know what causes the sun to be so hot. We do not know how the first life came to the earth. We do not know whether the earth will always be fit for habitation. Certainly the moon is not. Some think that the earth will slow down, losing after millions of years its heat, air, and water. But this is just a guess; we are in no way certain about it. Nor do we know whether other planets are inhabited; it would seem a great waste if they are not. Perhaps scientists will some day find out these things that are mysteries to us at the present time; perhaps they will never be known.





It took millions of years for these mountains to rise to their great height. During all these years the storms and glaciers have been at work, altering and tearing them down. The photograph shows Shadow Lake and a portion of the Minarets against the skyline, in the high Sierras of California.

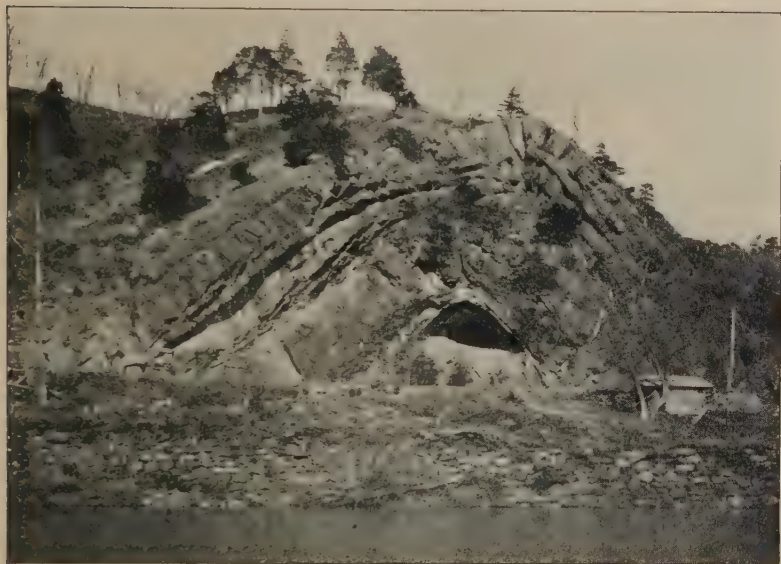
## III. THE MAKING OF ROCKS AND MOUNTAINS

It is supposed that the earth, intensely hot beneath its surface, gradually cooled. Little by little the white vapors which covered everything settled down into the water of the ocean. And the sea covered the whole face of the earth.

As the earth very slowly shrank together, the surface gathered itself into wrinkles or folds, much as a prune or an apple wrinkles in drying. Some of these folds, in time, rose above the water and became islands and continents. Some of the very earliest land that appeared was the beginning of North America. Although we speak of America as the *new* world, it is really the old world, because a part of it stood out above sea level when all the other continents, except two regions in northern Europe, were deep under water. This oldest land in North America is called the Laurentian V, because of its V shape and its relation to the St. Lawrence River. Its point is near Montreal, Canada; one arm extends northeast through Labrador, the other northwest toward the western side of Hudson Bay. The land that forms this V came out of the water, not because the water flowed away from it, but because a portion of the earth's crust was uplifted by a mighty force and rose above the ocean.

When the Laurentian V rose out of the water, it was made up of rocks as bare as the barest cliff you ever saw. There was no vegetation of any sort upon them. Because these rocks were unprotected by grass or trees, the action of rain and frost and the waves of the sea began to tear them to pieces, throwing them back into the sea in the form of sand and clay. And as fast as this broken rock material fell into the sea, the waves tossed it back. This process resulted in the addition of new land around the edges.

When material torn from rocks falls into water, it places itself in layers or strata. The larger portions fall to the bottom first, because their weight is greater in proportion



Stratified rock, bent upward in folding. It was the folding of stratified rock in this way on a very large scale that made most of our mountain ranges.

to their surface than that of the little pieces, which are carried farther by the current before they fall. For this reason all rock material that has built itself up under water is made of layers or strata. Whenever we see rock that lies in layers, we know it was formed under water, because, generally speaking, strata cannot form in any other way.<sup>1</sup> Sometimes the strata can be seen very plainly. Sometimes they can hardly be distinguished because the rock was built up from uniform material.

When strata are formed, they are nearly or quite level; but very often rocks that once stood level have become upturned or distorted. Sometimes strata are disturbed by a force so great that they are either set on end or completely

<sup>1</sup> There are rare exceptions, as in the case of ashes and cinders thrown out from a volcano. These often lie in strata, as does wind-blown sand sometimes in the desert or in dunes along the seashore.

overturned. It is in this way that mountains were generally made, by the crumpling and folding of strata as the earth's crust contracted and wrinkled in cooling. It is interesting to think that the material of which nearly all strata are composed once lay at the bottom of the sea.

Water falling on the slopes carries away, grain by grain, piece by piece, the rock material of the mountains, for there is no rock so hard that falling water will not tear some of it away. Whatever is torn from the mountains finds its way to the sea, to furnish material to build new rock layers, which in turn may be folded to form new mountains or raised to form level land. As centuries and ages pass, this process goes on endlessly, mountains rising and being torn down again by storms and frost.

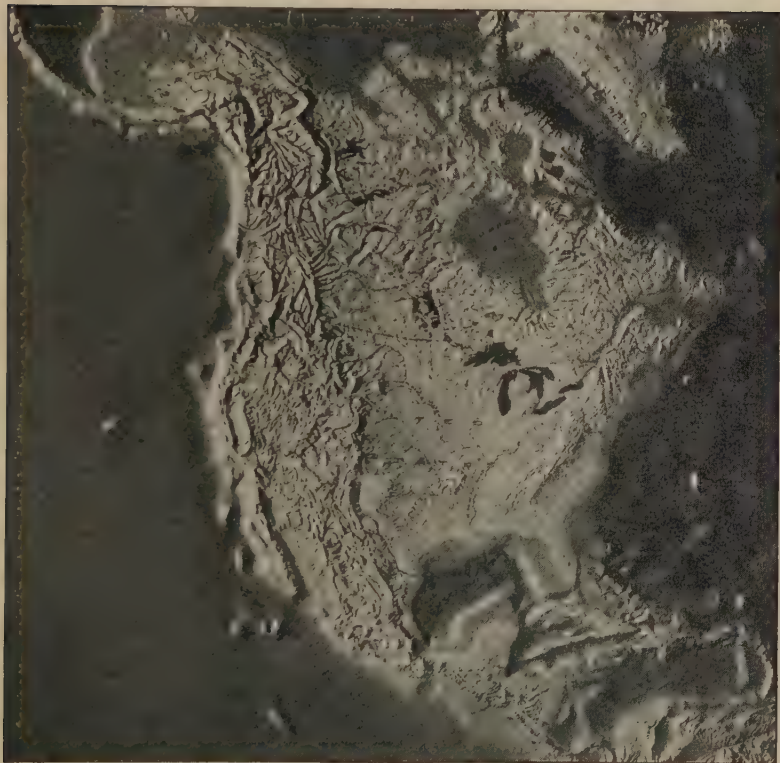
When they came out of the water, the first mountains were very much higher than they are now. If you go to Montreal and look northward from Mount Royal, as the great hill above the city is called, you will see that the Laurentian Hills are comparatively low and that they present a rounded appearance. In the beginning they probably rose to a much greater height, but they have been worn down low by the storms and streams of countless ages.

As time went on, the Green Mountains and the White Mountains, the Adirondacks of New York, and the mountains of Pennsylvania, Virginia, North Carolina, and northern Georgia arose from the sea.

Off to the west a portion of what is now Missouri and Arkansas early appeared as a low island of rock, which we call the Ozark Mountains. The water tore this to pieces, leaving sharp cliffs and gorges, just as it has always done whenever it finds a newly formed island.

Farther south other land emerged in much the same way, and a part of what is now northern Brazil came into view. In the region we know as northern and western Europe arose scattered islands. Such islands were the beginning of





Model of the North American continent, showing land masses in relief and also the relative depths of the bodies of water. Notice the two great mountain systems, the Cordilleras and the Appalachians.

all the future continents. Now these islands and mountains are all worn down low, because they have been out so long in the rain and the storms.

Ages and ages passed. Far out toward the Pacific coast hundreds of miles of stratified rock were uplifted and crumpled together to form the great mountain system which reaches unbroken from the Arctic Ocean to the far tip of South America, under various names — the Rockies, Cascades, Sierra Nevada or Snowy Range, Sierra Madre or Mother Range, and Andes. All these ranges were formed



*Copyright by Fairchild Aerial Surveys*

Airplane view of a portion of the Presidential Range in the White Mountains of New Hampshire. The peaks are named for our early Presidents: Washington, Adams, Jefferson, Madison, and Monroe.

out of many different folds or wrinkles; and a very, very long time it took to make them.

These western mountains are much higher than the ranges in the eastern part of the United States. This is because they are younger and have not yet been worn down so much, and moreover many of them were uplifted to a greater height and more recently than the eastern mountains. Out of the rock torn away from both of these mountain systems has been formed a large part of the rocks and soils of the Mississippi Valley, while the rest has come from the heights to the north.

#### IV. THE APPALACHIAN MOUNTAINS

##### THE MOUNTAINS OF NEW ENGLAND

No land is richer in beautiful mountains than North America, and her picturesque heights are not confined to any one locality, for the eastern part of the country has them as well as the western, and the ranges of each region abound in scenery of which all Americans are justly proud.

Among the most widely known of the eastern uplands in the United States are the White Mountains of New Hampshire, or the Granite Hills as they are sometimes called, because they are chiefly composed of granite.

Granite is a very hard rock, made up of countless little crystals of quartz and feldspar, generally with mica or other minerals. The quartz in granite is often colorless, as glass is. The feldspar varies from white to gray or to a reddish tone, giving the granite its characteristic color.

When the early English settlers came to Massachusetts, they saw many giant boulders lying about — great masses of hard, beautiful stone mottled and sparkling here and there, because of the crystals of mica scattered through them.

These boulders were granite, and because the people found them to be almost indestructible, they realized their value for building purposes. Before many years had passed, the settlers began making houses and public buildings out of them, and soon afterward quarries were opened for taking the stone from the ground. From about fifty years before the Revolution, the quarrying and dressing of granite has been one of the main industries of New Hampshire. In fact, the White Mountains are composed so largely of this rock that New Hampshire is called the Granite State. Granite boulders from the White Mountains are scattered over eastern Massachusetts. How they got there we shall tell later.

Mount Washington is the highest peak of the White



A granite quarry in the Green Mountains near Montpelier. Nature helps the quarryman by making many cracks or joints in the rock, thus saving him the trouble of splitting the blocks on all sides.



Mountains. Compared with some of the giants of the Rockies and the Sierra Nevada, it is little more than a hill; but to the Indians who lived in that region it was the loftiest place in the world. They believed it was a bridge that reached to heaven, and that somewhere on its summit the Great Spirit made his home. They told of a marvelous carbuncle he kept there, larger than any stone in the valley, and so bright that it blazed like a living coal. But because it was guarded by a devil who caused mists to arise whenever mortal footsteps came near, no human eye had beheld its glory. Many a man, they said, had lost his life in attempting to do so, because in the mists people fell to destruction over the crags.

When the white men came, they heard the tale from the forest people and were curious and eager to see the stone, but for a long time they too were afraid to venture up the mountain. Finally a bold man named Darby Field made the ascent, but he did not find any devil-guarded treasure. Scattered over the crest were some crystals which gleamed like diamonds, and thinking they were precious stones, the explorer filled his pockets with them and hurried back to the valley. The crystals proved to be nothing more than bits of quartz of no value whatever. Out of the Indian legend of the treasure which the Great Spirit kept on Mount Washington, Nathaniel Hawthorne made a story, "The Great Carbuncle," that is known the world over.

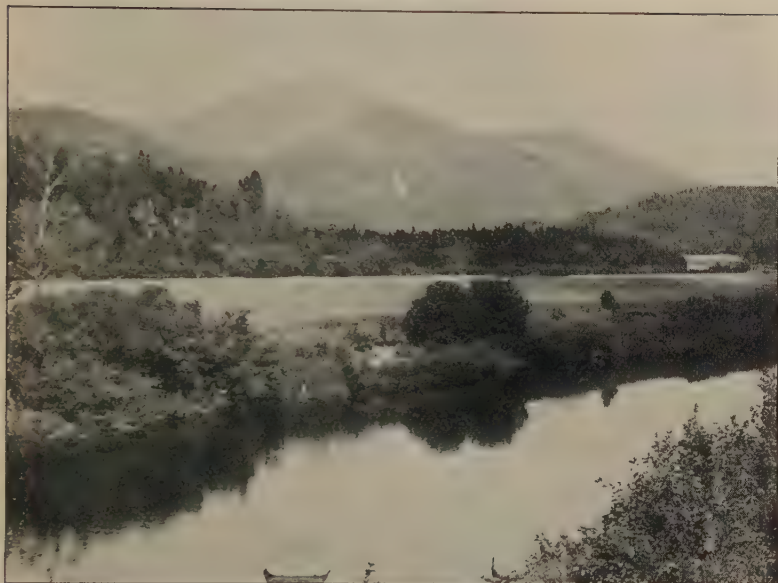
West of the White Mountains are the Green Mountains of Vermont, heights neither so lofty nor so extensive as those of New Hampshire but very beautiful, with slopes covered with forests and thickets. These mountains are not wholly composed of granite. The rocks out of which they were formed were made up of clay and sand deposits, washed down from the highlands to the east, and of lime from the hard parts of sea animals.

All lime deposits have come from the bodies, shells, and

crusts of animals that lived in the ocean. As billions upon billions of sea creatures have existed since the beginning of things, they have deposited a vast amount of lime when, in dying, they became part of the sea bottom. While the surface of the earth in the Vermont region wrinkled higher and higher in cooling, the pressure which caused the wrinkling heated and changed the clay, sand, and lime. With the passing of ages, the clay, when pure, became pressed together into flat sheets called slate, such as are still used for roofing houses and for blackboards in schools. The lime from the bodies of sea animals was transformed into marble, the kind you see in a monument or statue.

The New England highlands drop low in Maine, where there are only moderate elevations. The highest of these is Mount Katahdin in the central part of the state. Here is written a story of ancient earth foldings and uprisings similar to the ones recorded in the hills of Vermont and New Hampshire. Few places in America are richer in Indian relics than this peak of Maine. Around its base have been uncovered many primitive ornaments and implements of warfare. The reason for this is to be found in a story the northern Indians used to tell, one in which they believed as implicitly as Wako believed the tale of the wrinkled medicine man.

Long ago, they said, Katahdin was the home of the Thunder and Lightning Children, who lived in a cave at the foot of the peak. If a tribe broke the law of justice or was guilty of any other wrongdoing, the Great Spirit commanded the storm folk to go forth and smite the tribe. Then the people in the wigwams were filled with terror and took gifts of flint and wampum to the mountain's base so that the Great Spirit might smile on them again. That is why many woodsmen and summer vacationists at Katahdin have found hatchets and arrowheads imbedded in the leaf mold there. These articles were peace offerings made by the frightened forest folk of long ago.



*Copyright by Detroit Photographic Co.*

The Adirondacks near Lake Placid. The distant peak is Whiteface.

#### THE ADIRONDACKS

West of the Green Mountains, in the northeastern counties of New York, are the Adirondacks, a cluster of picturesque granite heights covered with rich vegetation. Trout brooks and waterfalls enliven their valleys, and scattered among them are numerous lakes. Saranac Lake and Lake Placid are the largest of these bodies of water. They are small as compared with many of our lakes, but what they lack in size, they make up in beauty. It is hard to imagine lovelier sheets of water than those of the Adirondacks.

The Adirondack country is one of the famous playgrounds of the United States. Thousands of pleasure seekers go there in winter as well as in summer, for in these rugged uplands each season is delightful. The winter carnivals at the lakes are famous; and during the warm months anglers and many others who are drawn by the canoeing and tramping



*Copyright by Detroit Photographic Co.*

The Blue Ridge, as seen from Mount Toxaway in the western part of North Carolina. This is a typical view of the southern Appalachian region.



and by the invigorating mountain air flock to these highlands of New York.

In the heart of the Adirondack Mountains a large tract has been set aside as Adirondack Park. This is the most splendidly wooded region in New York State, and because the people wanted it kept forever as an unbroken stretch of forest, the legislature made it a public park. Consequently the noble trees that stand there will not be cut down. No lumbermen or sawmills will be permitted to destroy the beauty nature lavishly gave to this region. The Adirondack forest will be a joy to the people of the future, just as it is a joy to those of today.

#### THE ALLEGHENIES AND THE SOUTHERN RANGES

The White Mountains, the Green Mountains, and the Adirondacks comprise the northern part of the great Appalachian system. South of the Adirondacks are the Allegheny Mountains, which extend across the states of Pennsylvania and Maryland, and down along the border between Virginia and West Virginia. The Alleghenies are not everywhere so rugged as the Adirondacks, but they are picturesque and contain numerous springs and clear, swift streams. It is the abundance of water in these eastern mountains that gives them their charm.

The Cumberland Mountains extend along the border between Virginia and Kentucky and southward into Tennessee. Between Tennessee and North Carolina is the higher range of the Great Smokies, and farther east lies the Blue Ridge, the eastern wall of the Appalachian chain. These ranges, for the most part, are neither rugged nor high, but their slopes are green with trees, and in spring and summer gay with wild flowers. Among the most beautiful of the flowers are those of the rhododendrons, tall, gorgeous shrubs that bloom in May and June, making vivid patches of rose color along the slopes and gulches.

In these mountains we find also various species of azaleas and the mountain laurel or kalmia, a large shrub with shining, dark green leaves and dainty rose-tinted flowers. This American laurel has little in common with the laurel or bay tree of Europe, celebrated in poetry and legend as the emblem of victory. All species called laurel have large, glossy, evergreen leaves, but ours has splendid blossoms very different from the small flowers of the laurel of Europe.

From the slopes of the Blue Ridge flow southeastward many streams marked by waterfalls. The most interesting of these cascades are in northeastern Georgia, in the gorge which the Cherokees called Tallulah, and it still bears that beautiful Indian name. This gorge is the most remarkable in the entire Appalachian system and the finest in the United States east of the Rocky Mountains. Tallulah is marked by five waterfalls, forming together a gigantic, irregular staircase of white rock. On both sides of the river there is a dense growth of trees, and the foaming water against the dark verdure of the forest is a beautiful sight.

Few sections of the world are richer in variety of trees than the Appalachian ranges, especially the Blue Ridge and the Great Smokies. They have more than a hundred different species of trees, while in the Sierra Nevada Mountains there are only fifteen different species. Because the many varieties of trees take on varied hues with the approach of cold weather, the southern Appalachians in the autumn are a sight the beauty lover can never forget.

The Great Smoky Range is the highest of the Appalachian system. But the loftiest peak is in the Blue Ridge—Mount Mitchell in North Carolina, which rises 6711 feet above sea level, about five hundred feet higher than Mount Washington. This is the highest mountain east of the Rockies. It is clothed with dark balsam firs, under which is the richest of mountain vegetation.

The southern spurs of the Appalachian system in northern



Airplane view of Stone Mountain in Georgia, a lone rounded knob of granite in a relatively level country.

Georgia are not very high, but a detached member, Stone Mountain, rising above the plain near Atlanta, is of great interest. It looks like a gigantic boulder, for its granite surface is bare of trees, and its jagged edges have been worn away. The storms of countless years and the wash of the rivers have torn away the softer rock masses of which it was once the center, leaving a huge rounded mass in the midst of a plain. There it stands, bald, impressive, and solitary.

Stone Mountain is especially noteworthy because it has become a unique and noble monument. Upon its majestic side, in the native granite, there is being carved a frieze showing actors and incidents of the Civil War. This picture in stone will be one of the notable sights of the United States.





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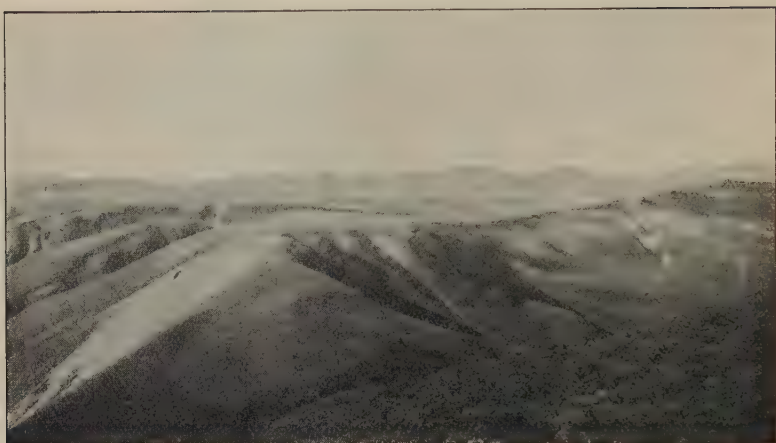
Airplane view of the Rocky Mountains to the west of Longs Peak, Colorado, near Estes Park. Bare, rugged peaks and year-round snowfields are characteristic of the Rockies.

## V. THE ROCKY MOUNTAINS

America's loftiest and grandest ranges are the Rocky Mountains and the Sierra Nevada. The Rocky Mountains extend from Mexico across the United States and Canada, and through Alaska to Bering Sea. Scattered throughout this great mountain system are summits that tower two miles or more above the sea level. In Colorado alone there are many peaks that reach a height of 14,000 feet and over. Indeed, of the ten highest peaks in the United States seven are in Colorado. Loftiest of these is Mount Elbert, 14,420 feet high. Pikes Peak, although not so high, is more noted than these other peaks, because it was a great landmark of the westbound pioneers and figures in numerous stories of the men who built the West. "Pikes Peak or bust" was a common slogan of those days. Another mountain of Colorado famous as a landmark among those who crossed the Rockies is Longs Peak, a little higher than Pikes Peak and farther to the north. It stands as the background of the picturesque Estes Park.

The Rocky Mountains have great height because they are relatively young. The folds in the earth's crust that formed them were crumpled together many ages after those that made the Appalachian system, and consequently they have not been worn down low by storms and time. They are not covered with rich vegetation like the Adirondacks and the Blue Ridge; in fact, many of their peaks rise far above the timber line. Many of their highest canyons and slopes have perpetual snow, and in their magnificent altitude and ruggedness these mountains are awe-inspiring and sublime.

The main chain of the Rocky Mountains forms what is known as the Continental Divide or the Great Divide, the watershed from which streams flow westward to the Pacific and eastward to the Gulf of Mexico. The term "Great



Looking along the Continental Divide, from a point near the head of Elk Canyon, San Juan Mountains, Colorado; about 12,600 feet above sea level.

Divide" has been much used in poetry and story to signify the entire Rocky Mountain system.

One of the most striking of all the peaks in the Rockies is the Grand Teton in Wyoming, because it is the steepest in the United States. It rises above a clear body of water known as Jacksons Lake to an altitude of nearly 14,000 feet, with sides so sheer and jagged that it has often been compared to the Matterhorn of Switzerland, famed as being the steepest high mountain in the world. It is very difficult to climb mountains of this kind, and usually the way up has to be sought again and again before it can be found. For a long time the Grand Teton was counted among the peaks that could not be climbed.

## VI. THE SIERRA NEVADA

The mighty range called Sierra Nevada is a long distance west of the Rockies. It extends from the southern part of California nearly to the Oregon line; from that point northward it is known as the Cascade Range. Mount Whitney

in California, near the head of the Kern River in the central part of the Sierra Nevada, is the highest peak in the United States, rising 14,500 feet above sea level. Next highest in the Sierras is Mount Williamson, towering almost as high as Mount Whitney. On this mountain small glaciers still remain. In the same vicinity are a dozen other summits that rise more than 13,000 feet above the sea.

The Sierra Nevada is broken by many canyons, or gorges, through which rivers sweep on their journey to the lowlands. These rivers are fed by the snowfall on the high peaks, and are clear, swift streams abounding in trout. In the granite basins are countless lakes, small, ice-cold, clear, and sparkling.

There are forests in the Sierras too, the most glorious of any in the world. The groves of these California mountains are beyond comparison nobler than those of the Alps, for the woods of Switzerland are mainly second growth and are mere brush beside the huge pines, firs, and spruces of America's western ranges. In the forests of the Sierras, towering above all the other vegetation, so lofty in height and great in circumference that it defies competition, grows the giant sequoia, mightiest tree on earth.

No matter where he goes among these mountains, the nature lover is sure to find glorious scenery of an amazing variety. "Frost-torn peaks of every height and bearing pierce the blue wastes above, their slopes dark with forests of giant trees. Dropped here and there, gleam turquoise lakes which mark the craters of dead volcanoes, or swell the polished basins where vanished glaciers did their last work. Through mountain meadows run swift brooks o'erpeopled with trout, while from the crags leap full-throated streams, blown half away in mist before they touch the valley floor. Far down the fragrant canyons sing green and troubled rivers, twisting lower and lower to the common plain."<sup>1</sup>

<sup>1</sup> Quoted from Dr. Jordan's *The Days of a Man*.





Airplane view of the head of the Kern Valley, approaching Mount Whitney.

Throughout June, July, and August the meadows that lie between the mountain ridges are masses of gorgeous flowers. Numerous varieties of these flowers there are, azaleas, Indian paintbrushes, lupines, tiger lilies, harebells, and many others, each beautiful in its own way and contributing to the vivid color effect of the mass of mountain growths. Perhaps the loveliest of all are the Mariposa lilies, with their exquisite blossoms of three petals, pale pink, flesh, or light yellow in hue, and on each petal a blotch of brown. There is hardly a more delightful sight anywhere than a Sierra meadow carpeted with Mariposa lilies. These radiant flowers grow on slender, rather long stems, and as they sway in the wind, they seem like countless fluttering butterflies. Mariposa, indeed, is the Spanish word for butterfly.

An extraordinary vegetable growth, a parasite on the roots of evergreens, is the snow-plant (*Sarcodes*), which

springs up on the fringe of melting snow. Every part — stem, leaf, and bloom — is a vivid red.

The Coast Range, extending along the Pacific shore of the United States, is not nearly so lofty as the Sierra Nevada. The Sierras were folded and crumpled together with great force, and then the whole block of which they are a part was cracked and tilted up on the east. The Coast Range was less closely folded and is not so high.

In the Coast Range we find forests of great trees, especially the redwood, not so large as the sequoia of the Sierras, but a monster as compared with the pines, firs, and the other trees we know. Of other notable trees and shrubs, the most striking is the madroña (ignorantly called madrone). It is a noble tree with large, shining evergreen leaves, and it casts its outer bark at times, revealing each year the smooth orange buff of the inner bark. Bret Harte called the madroña the Robin Hood of the forests.

Captain of the western wood,  
Thou thatapest Robin Hood!  
Green above thy scarlet hose  
How thy velvet mantle shows!  
Never tree like thee arrayed,  
O, thou gallant of the glade!

The blue blossom, or California lilac, a shrub found frequently in the Coast Range, is not like a lilac in any respect, but it is very attractive because of its sky-blue flowers, a color almost unknown among trees or shrubs.

The California Indians said that the Sierras are so much higher than the Coast Range because, once upon a time, there was a quarrel between a hawk and a crow. It was so long ago, they declared, that there were no mountains nor valleys, and the whole world was flat like a floor and covered with water. Away to the south, in the place white men call Tulare Lake, a pole was standing. It rose high above the water and on it sat Hawk and Crow. There was not enough

room for both of them at the same time, so Hawk sat there awhile until Crow knocked him off and took his place. Thus many moons passed, and all the while the two took turns at sitting on the pole.

One day, while Duck was swimming on the water, she suddenly dived down to the bottom of the lake and filled her bill with mud. She died on the way to the top and her body floated on the water. Seeing the mud in her beak, Hawk and Crow took it and commenced making mountains. They started at the same place and worked in different directions, Hawk building the eastern range, and Crow the western one. It was hard work and they had to push the mud deep into the water, and then pile it high. But they did not stop to rest, and slowly, steadily, peaks arose, until the ranges came together at Mount Shasta. Then they stopped to rest and to view the work they had done.

The western range was much higher than the eastern, and Hawk was angry.

"You have stolen my mud," he screeched at Crow. "That is why your part is higher than mine."

Crow did not answer. He only sat and laughed. This enraged Hawk so much that he took hold of the mountains and twisted them around in a circle. He put his own range where Crow's had been, which made his side much higher than the other. It towered so far above the sea that the peaks pierced the clouds. That is why the Sierras are higher than the Coast Range.

## VII. THE SIERRA MADRE, THE MOUNTAINS OF MEXICO

As they go southward, the Sierra Nevada and Rocky Mountains approach each other, and under the name of Sierra Madre — Mother Range — the great mountain system continues through Mexico. Here we find numerous volcanic peaks, the most noted of which are Popocatepetl and Orizaba, both snow-capped the whole year long. Popo-



catepetl — Smoking Mountain, as the name means — stands about forty miles southeast of the City of Mexico. It towers to a height of more than three miles, and the sight of it with its neighboring lofty summits is one of the finest views in all the world. On the plain below are picturesque towns, with trees and gardens making varied patches of color and the gilded domes of churches gleaming in the sun.

Next to Popocatepetl stands the high volcanic ridge called Iztaccihuatl, "the Sleeping Lady," because its long, snowy crest suggests a recumbent figure. Farther east, partly detached from the main mass of the Sierra Madre, is the huge peak of Orizaba, the highest mountain of Mexico, and indeed the highest in North America, excepting Mount McKinley and Mount Logan, standing close together on the Alaska-Yukon border. Aside from its great altitude, Orizaba is one of the most interesting mountains in the world, because along its eastern slope is to be seen the vegetation of every climate from that of the tropics to the Arctic. At its base are the luxuriant growths of the warm lowlands. Gradually, with increasing altitude and increasing cold, these give way to the plants of temperate regions, and finally, as one approaches the snow-covered summit, one finds dwarf pines and the scant vegetation of very cold lands.

About three miles from the City of Mexico is the rocky eminence of Chapultepec, rich in historic associations. When the Spaniard came to the New World, it was occupied by the Aztecs, the ancient inhabitants of Mexico. But the white conquerors overcame these people and took the place for themselves. They built a fortified castle upon its crest, and during the wars that have inflamed Mexico, this fortress has been taken and retaken by attacking forces. The base of Chapultepec is surrounded by a beautiful park and is a favorite pleasure resort of the Mexicans.

Central Mexico consists mainly of a high plain called Tierra Templada, a region with a mild climate. The



Peaks of the Sierra Madre, with a stretch of desert in the foreground.

northern part of this section is relatively barren, made up of dry hills and arid plains like parts of New Mexico and occupied by cattle ranges. Farther south, however, the land is well adapted to agriculture, though it is not so productive as it might be, because of the primitive farming methods employed by the people.

The Tierra Templada breaks off sharply on the east, giving way to the Tierra Caliente, or hot coast region. In both climate and products this is a very different country from the Tierra Templada, being neither so pleasant nor so healthful.

The ruins of ancient Mexico are of abounding interest to those who try, by study of buildings and inscriptions, to secure knowledge of ancient life. Notable among these are the sacred pyramids of the Sun and Moon, the former 216

feet high, at the Aztec "City of the Gods" (San Juan Teotihuacan) near Mexico City. They are built of blocks of basalt covered with earth. At the top of the larger one, scarcely smaller than the Great Pyramid of Egypt, was a gigantic statue of the sun, made of a single mass of porphyry adorned with gold.

The ancient city of Palenque in the state of Chiapas was the first of the many towns of great stone palaces with carved inscriptions to be brought to light in our times. Its site, now overgrown with giant forests, covered some twenty square miles, and what lies buried under the trees no one knows. Chichen-Itza and Uxmal in Yucatan, long inaccessible, are of equal importance, and the inscriptions on their palace walls show fine taste and a high degree of civilization.

Near the city of Oaxaca are the ruins of Mitla, less extensive and elaborate than the others, but better and longer known. These, with their ancient inscriptions and elaborate adornments, have been carefully preserved by the government of Mexico.

## CHAPTER TWO

### A STORY OF HEAT FORCES WITHIN THE EARTH

#### I. THE PALISADES OF THE HUDSON

IF fairy tales were true and wizards with magical tools were to work for thousands of years to make marvelous cliffs and columns, they could not create anything more amazing than Mother Nature created while this old earth was in the process of making. Nature is the greatest of architects, and when once you have learned to read her story and to understand the marvels around you, you will find traces of her splendid building everywhere you look. Sometimes her tools are the rivers and rains. Sometimes she uses heat, which she always keeps stored away so that it will be ready whenever she needs it, and very wonderful are some of the rock masses she has piled up by setting this heat at work.

Along the Hudson River on the other side from the great city of New York and almost within sound of its traffic, is a long range of cliffs edging the stream. This abrupt wall of even height bounding the river on the west is called the Palisades, and to the geologist it is especially interesting.

The Palisades are made up of a mass of huge columns, usually with five or six sides. Scientists say that this mass of columns was formed ages ago by an intrusive sheet of lava, of the form called basalt. An intrusive person is one who pushes in where he has no business to be, and an intrusive sheet of lava is molten rock material that does somewhat the same thing.

The molten rock that made the Palisades pushed itself up from the depths of the earth in a wide stream. It wedged in between the surface rocks, which were mainly sandstone, and those below the surface, composed chiefly of hard shale. Just as a wedge of wood or iron separates the material into



The Palisades of the Hudson, showing the rugged columns and the mass of loose rocks that have broken off from the face of the cliff and rolled down to the water's edge.

which it is driven, this broad intrusive sheet separated the rocks and forced them apart. When basalt shrinks in cooling, it forms columns, and these columns are shaped by the pressure of one against another. As six basalt columns naturally press against each other, they are normally six-sided, though occasionally they have five, seven, or eight sides.

As ages passed, the rains, the frost, and the river acted upon the surface rocks of this region, and the sandstone at the edge of the lava sheet was worn away. This left the rock columns standing out distinctly. They are less distinct now but can still be seen, though the lava sheet has been worn down and a good deal of the rock has been carried away for road building. Until a few years ago, in the old



part of the city of New York near the Hudson River, many of the streets were paved with blocks from the Palisades.

The Indians of the lower Hudson called the Palisades the wall of the Great Spirit, and they used to tell this story about how it came to be piled up there like a fortress guarding the stream.

Ages ago, far in the west country, people were starving and dying because of a famine. Women and children cried beside the empty food baskets, and the braves lay in the wigwam doors, too miserable to know or care anything about what was happening around them. The tribe was perishing, and a good old medicine man, the only one among his people who was still untouched by the famine that had taken so many, prayed to the Great Spirit for help.

Then a marvelous thing happened. In a cushion of cloud appeared the face of the Great Spirit, and a voice spoke, telling of a country in the land of the rising sun, where there were nuts and fish and game enough to feed many tribes.

Strengthened by hope, they set out upon the long journey and although many died by the way, a few came at last to a pleasant region through which flowed a noble river. Here they built villages and prepared to make their home; and here, in the heart of a fishing and hunting country, they prospered and were happy.

After a while sorrow came to them again, for some giants who lived in a region west of the river swept over into their hunting grounds and stole their game. These giants made war upon this peace-loving people and killed many of their braves, and again it seemed that the tribe would die out. But the Great Spirit pitied them, even as he had pitied before. He piled up a wall of cliff along the west bank of the river, a wall so high that the wicked ones could not cross it. And ever afterward the tribe lived undisturbed beside the stream.

When the white men came, they named these cliffs the

Palisades, and so they are called to this day. But the Indians, who believed the story their fathers told, always spoke of them as the wall of the Great Spirit.

## II. LAVA OUTFLOWS

### THE DEVIL'S POSTPILE

In many places unequal pressures under the earth's surface have caused rock masses or strata to crack, and one side or the other may rise or fall. Geologists call these dislocations faults.

Usually faults are comparatively small. An earthquake witnessed by John Muir in Yosemite National Park resulted in a surface faulting in the mountains and the rising of a rock wall twenty-five feet high. But sometimes faults are hundreds of miles long, and when they are deep enough to reach melted rock, lava may gush out at the surface. Through such a fault, in ages long past, burst the lavas which built up the Cascade Range in Washington and Oregon.

Through faults of lesser length than that, but of great depth, occasionally lava will emerge which, on cooling, crystallizes into close-standing, upright columns of the rock called basalt. These columns range from one foot to several feet in diameter and usually have five or six sides. When portions of them are disclosed by the washing away of the surface earth, people often travel hundreds of miles and climb high mountains to see them.

The most striking example of this formation is the Devil's Postpile on a forested hillside in the high mountains a few miles southeast of Yosemite National Park. This mile-long mass of upright columns is exposed to a height of several hundred feet in places. On its outer side, many columns have fallen and broken into fragments, forming a steep hill along its base. One may imagine it the woodpile of a family of Titans, and in fact small examples elsewhere are sometimes called Devil's Woodpiles. There is an interesting Devil's



The Devil's Postpile in the Sierras southeast of the Yosemite.

Woodpile in Placer County, California, about six miles south of Summit, a station on the Central Pacific Railway.

Another remarkable example of basaltic columns is the Devil's Tower in the Black Hills of Wyoming. This rises from a broad plain to a height of six hundred feet, with a top diameter of a hundred feet. Suggesting an enormous tree stump, it is visible for many miles in all directions. It is not until the visitor is close to it that he sees the flutings which

show that this immense rock mass is composed of innumerable many-sided columns clinging closely together.

Some geologists think that on this spot molten rock was pushed up nearly to the surface. The columns of basalt that we see today indicate that the molten rock cooled from the surface downward. During the hundreds of thousands of years since then, the softer surrounding rocks have been worn away, exposing the rock called the Devil's Tower.

#### EAST ROCK AND WEST ROCK

There are two lava masses of the nature of dikes in Connecticut, about thirty miles west of the place where the Connecticut River empties into Long Island Sound. They are at the northern edge of the city of New Haven, one toward the east and the other toward the west, and so people call them East Rock and West Rock.

A good many millions of years after the masses now known as East Rock and West Rock were formed, three men named Goffe, Whalley, and Dixwell came over from England. They were called regicides because they had been members of the body that condemned to death the English king, Charles I. These three men fled from England to New Haven, a little village then, and climbing upon West Rock, found a great boulder lying across two others, so as to form a space underneath in which they could sleep. Here they stayed for a time, and in the black rock above them they carved this inscription, "Oposition to tyrants is obedience to God." They put only one *p* in the word *opposition*, perhaps because the lava was hard to cut; but it served the purpose just as well as two.

### III. THE GREAT EARTHQUAKE RIFT

The cracks into which molten rock flowed to form dikes were in most cases comparatively small. But in some places, as the earth's crust broke in cooling, long cracks were formed,



Model of California, showing the location of the numerous fault lines (indicated in black) that traverse the rocks of the state.

and these extended downward through the rocks to a great depth — as far as the cooler part of the earth extends. Such long breaks are called earthquake rifts, and there are many of these on the surface of the earth. On both sides of the Pacific Ocean there are several earthquake rifts where the earth's surface has been broken apart in the process of mountain making.

Dr. John Casper Branner, one of America's foremost geolo-



gists, once said that a fault zone is like a fracture line in a bone that has been broken. It represents a weak place that will give way under strain. But just as a broken bone will in time be naturally renewed, so a faulted rock bed may finally become cemented by hardened lava. Some earthquake rifts have been thus cemented and closed by upward-flowing lava, but others have not been; and wherever the rift remains weak and uncemented, earthquakes are likely to occur.

The great earthquake rift of western America is a curving crack that runs from north to south, extending far down into the earth, maybe forty miles and maybe less. Some people speak of it as the California rift or San Andreas fault, but it is not confined to California and still less to the tiny valley of San Andreas. It begins far up in the Bering Sea beyond the Bogoslof Islands and extends southward through the ocean bed just beyond the coast until it strikes the California shore about one hundred miles northwest of San Francisco. From there it goes southward, sometimes through the land and sometimes under water, until it reaches the Gulf of California. It traverses the floor of two bays, Tomales Bay and Bolinas Bay, both of which lie between San Francisco and the point in Mendocino County where it first enters the land from the sea. A little south of San Francisco it strikes the shore again and runs in a nearly straight line southward for about two hundred miles. Then, curving eastward, it extends through Cajon Pass and near the San Bernardino and San Jacinto mountains and the great irrigated valley of Imperial, where it disappears beneath the waters of the Gulf of California. So far as we know, from the point where this rift runs under the Gulf of California it follows the western coast of Mexico under water and extends still farther southward to the shores of Chile and Patagonia. It is by no means proved that the fault extends in an unbroken line through this entire distance,



Effects of the earthquake of 1906 at Olema, California. The disturbance caused this break of sixteen and a half feet in the fence.

but all along its line great earthquakes have occurred at the rate of about once in every forty years.

Many curious things happen, besides the shaking of buildings, when an earthquake occurs. Rocks are ground to pieces, and this causes deposits of soft, loose soil along the line of faults. It is easy for streams to cut their courses through this loose soil, and ponds and lakes are naturally formed in the depressions that occur in the rift.

The soft, loose soil of the California earthquake rift is



A highway broken up by cracks from the earthquake of 1906.

marked by lines of valleys, courses of streams, and a series of reservoirs and ponds, some natural, some artificial. It is marked, too, by a series of dairies, as the land where the rock is crushed is better grass land for dairy cattle than the hills adjoining it.

About forty years before the partial destruction of San Francisco by the fire of 1906, a great earthquake shook the California coast. The grinding of rock along the fault at that time left a long line of furrows or depressions. Several

years later the people of San Francisco took advantage of the break left by the earthquake and built a series of dams across it. In this manner they made the Crystal Springs Lakes or Reservoir. The water mains to carry water from the reservoir to the city were laid in a depression of the rift.

When the earthquake of 1906 came, the water mains were all crushed by the grinding of the walls of the rift, just as the rock had been originally broken ages before. San Francisco had no salt water pumping plant or other source of water except the Crystal Springs Reservoir. Therefore it was impossible to fight the flames and the greater part of the city was burned to the ground.

#### IV. THE BOGOSLOFS, ISLANDS OF MYSTERY

You remember that the earthquake rift of western America extends southward from the Bering Sea by way of the Bogoslof Islands. The Bogoslofs lie about thirty-seven miles northwest of the island of Unalaska. There are two of these islets now, although three have risen from the sea, hot and steaming, within historic times. Special interest attaches to them from the fact that the third of the group appeared at the time of the San Francisco earthquake of 1906, so that it is natural to suppose that there was a connection between the disturbances at Bogoslof and the earthquake at San Francisco.

Dr. Jordan, the senior author of this book, first saw the Bogoslof Islands in 1896, while on his way to the Pribilof Islands in connection with the fur-seal investigations. The United States government wished to solve the problem of the seal fisheries, and sent him to the far north to conduct an investigation. At that time Old Bogoslof, known to sealers as Castle Island, was cold and dead, although about a hundred years before it had risen steaming hot out of the sea. It showed in the fog as a sheer cliff or hill of ashes and



lava from three to four hundred feet high. It was apparently the home of countless seabirds, and a small herd of gray sea lions was drowsing upon its shore.

About half a mile to the northwest lay the islet of New Bogoslof, about twice the height of the other and of greater area. This island was known as Fire Island, having but recently ceased to steam and smoke. It had risen only thirteen years before, in 1883, and although there was no evidence of activity about it in 1896, the water in the crevices of the rocks was said to be still warm. Both islands were surrounded by water 3600 feet deep, and the second island lay directly on a route that had formerly been safely traversed by vessels.

So far as we know, no one witnessed the rise of the second and third islets of the Bogoslof group. There is a story that the coming of the first islet was seen by a Russian trader who, with some native hunters, was forced to seek refuge from a storm on the north end of Unimak, an island of the



The second Bogoslof Island in Bering Sea as it rose from the ocean hot and steaming in 1883; a most remarkable volcanic dike in water of 3000 to 4000 feet depth.



Aleutian chain not far from the Bogoslof group. The Russian trader told a famous explorer named Kotzebue of the strange sight. This is how Kotzebue repeats the tale.

“They saw to the north, several miles from land, a column of smoke ascending from the sea. Toward evening they observed under the smoke something black, which rose a little above the surface of the water. During the night fire ascended into the air near the spot, sometimes so violent and to such a height that on their island, which was ten miles distant, everything could be distinctly seen by its light. An earthquake shook their island, and a frightful noise echoed from the mountains in the south. The poor hunters were in deadly anxiety. The rising island threw stones toward them and they every moment expected to perish. At the rising of the sun the quaking ceased, the fire visibly decreased, and they now plainly saw an island in the form of a pointed black cap. A month afterward, when the trader visited the new island, he found that it still threw out fire and that it had become considerably higher. After that time it threw out less fire but more smoke; it increased in height and circumference and often changed its form. For four years no more smoke was seen, and in the eighth year the hunters resolved to visit it, as they had observed that many sea lions resorted to it. The waters surrounding it were found to be warm, and the island itself was so hot that in many places they could not tread upon it.”

If it is true that the Bogoslof Islands are on the line of the earthquake rift, they must be accounted for as an out-flow from it. Although three of these islands have risen from the sea, the last one of the group, the one that rose at the time of the earthquake of 1906, is said to have been washed away before it became firmly established.

## CHAPTER THREE

### MOUNTAINS THAT FLAME AND SMOKE

#### I. MOUNT SHASTA, LASSEN PEAK, AND OTHER VOLCANOES

IN the northern part of California, where the chains of the Coast Range and the Sierra Nevada approach each other until they seem about to meet, there is a huge, symmetrical mountain which always wears a snowy crown and about half the year is covered by a snow mantle to its base. This is Shasta, and a very noble sight it is, as it stands there in isolation, for the neighboring summits seem low beside this kingly peak. The Indians said it was the tepee of the Great Spirit, and feared it as they feared the thunder and lightning that threw lines of fire across the sky. Nothing could tempt them to set foot upon its slopes, because from their fathers and their fathers' fathers they had heard that smoke from the fire the Mighty One kept burning had come out of a hole near the top long ago. Thus a story spread among them of how the peak came to be there.

It was so long ago that there were no mountains or valleys or rivers flowing seaward. Old Man Above, who is the same as the Great Spirit, lived up in the clouds, higher than the sun and the moon. As there was no one else in all that vast cloud region, he grew lonely and wanted to go where he might see other things than those at which he had looked for so many thousand moons.

One morning he took a sharp rock, bored a hole through the sky, and looked below. There lay the world. It was a very different world from the one we know, for instead of having green valleys and tree-covered uplands it was as flat as a table. Old Man Above did not like it.

"I will make a better place of it," he said. Because he



Mount Shasta, in northern California.

was so mighty, he could do whatever he chose ; so he began pushing snow and ice down through the cloud hole, piling it on the flat black earth like a cone or mound.

Daytime and nighttime he kept working hard and fast until he had finished the peak we call Mount Shasta. It looked so beautiful that he took it for his tepee. He built a fire there, for the Great Spirit in his might can make fire even on ice and snow. Then he made a hole near the top so that the smoke might pass out and not bother him.

A long time he stayed there, and all the while thick dark whirls of smoke poured out through the hole and floated far above the peak. Then he went away. Because there was nobody to tend the fire, it died out, and smoke from the tepee of the Great Spirit no longer moved in gray rings toward the sky.

When the white men came and heard the tale from the tribesmen, they smiled and called it Indian superstition. But after a time men who understood the science of geology traveled that way and discovered, as they climbed the peak, that the Indian legend had a foundation in truth. By the records written on the rocks along its slopes, they knew Mount Shasta was a volcano, which is a mountain that sometimes sends out ashes, lava, and clouds of vapor that look like smoke. Although it was believed to be extinct, they knew it had been active in the past. So the Indian story was not all make-believe, even though Mount Shasta had not been formed by snow pushed down from a cloud country, and Old Man Above had never lived there and kindled a mighty fire.

Though no outbreak of lava has occurred at Mount Shasta within the time of which man has a record, signs of life are still to be seen about this peak. There is a spot near the summit from which steam issues regularly, showing that the heat forces within the great mountain are not wholly extinct.

Volcanic forces have, however, given abundant evidence of life in Lassen Peak, another mountain of northern California. About seventy years ago people who lived in that part of the country were amazed to see great clouds pouring from it. Thick gray mud came flowing down the slopes like rivers of molasses, stiffening and hardening as it flowed. Children in California began to ask, "What causes volcanoes? What is it that suddenly causes mountains to send forth fire and ashes and lava?"

The answer to these questions starts with the fact that the interior of the earth has a terrific heat. This fact is well known; it is illustrated by the temperature of mines, which increases according to their depth. Down in this hot interior region, steam and other gases are imprisoned with the rock material. There is tremendous pressure there, and sometimes it happens that this hot material with the im-



Lassen Peak in eruption; the southernmost of a line of volcanoes, mostly extinct, that make up the Cascade Range.

prisoned gases is forced to the surface of the earth. It breaks through the crust with a great explosion, and cinders and ashes fall, and melted rock flows over the surface of the land. This is what we know as a volcanic eruption.

Volcanoes are found at intervals throughout the Cascade Range, and indeed this whole range is formed mainly of lava. The series of volcanoes continues across Alaska and along the Aleutian Islands—lava mountains all the way to Kamchatka and Japan. At some time in the past earthquake rifts occurred in the region where these mountains now stand. During the many disturbances that took place when the mountains were forming, rivers of lava flowed out of the breaks, and this flow gradually filled up the rifts. As time went on, the volcanic peaks poured out lava and covered the adjacent land.

First in the group comes Lassen; then Shasta, its gigan-





Mount Rainier, a snow-crowned peak of the Cascades. Long ago this was an active volcano.

tic cone broken near the top by an old crater, still warm, which the Indians called the smoke-hole of the Great Spirit. Then follows a series of peaks — Mt. Hood, Mt. St. Helens, Mt. Rainier (which is about 14,400 feet in height, a little higher than Shasta), and Mt. Baker. Passing northwestward into the Alaska-Yukon region, we come to Mt. Edgumbe at Sitka, Mt. Fairweather, Mt. Logan, Mt. St. Elias, and the highest of all, Mt. McKinley. Then come Katmai and Shishaldin, the latter a peak of perfect form, still active and apparently standing in water up to its knee. On the Alaskan mainland, also, and on one of the islands fringing its southern shore are Pavlof and Makushin. So you see that the western shore of North America has a very long chain of living and dead volcanoes. The famous Fujiyama, the pride of Japan, must be regarded as belonging to the same majestic series.

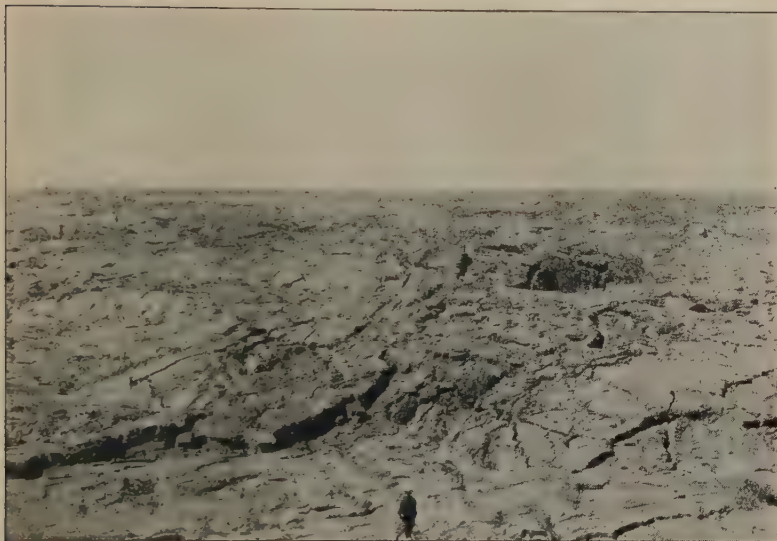
## II. THE STORY OF A STRANGE LAND — THE YELLOWSTONE

When only a small amount of lava flows out of the earth, it cools and hardens as it flows. But when the western mountains were being formed, a vast quantity of molten rock poured out through fissures in the crust of the earth and remained in a liquid state long enough to spread over wide stretches of country. Thus it happened that hundreds and even thousands of square miles were covered by it, and when this lava finally hardened, these regions were deeply over-spread.

Lava beds cover a large portion of northeastern California, part of Nevada, much of Oregon, Washington, and Idaho, and large areas in Montana, Wyoming, Arizona, and New Mexico. The volcanic forces under some of these areas have been at rest a long time, although they were once very active. But elsewhere in this region volcanic forces are still at work, and because they are working, strange things are even now taking place among our western mountains.

One of the places where the forces of steam are most active, where amazing things have happened in the past and are still happening, is Yellowstone Park, a wonderland of the Rockies that lies in the northwest corner of Wyoming. Here are to be found hot springs, "mud volcanoes," spouting geysers, petrified forests, and many other marvels. The story of how they came into existence is one of the fascinating tales in the great world of science.

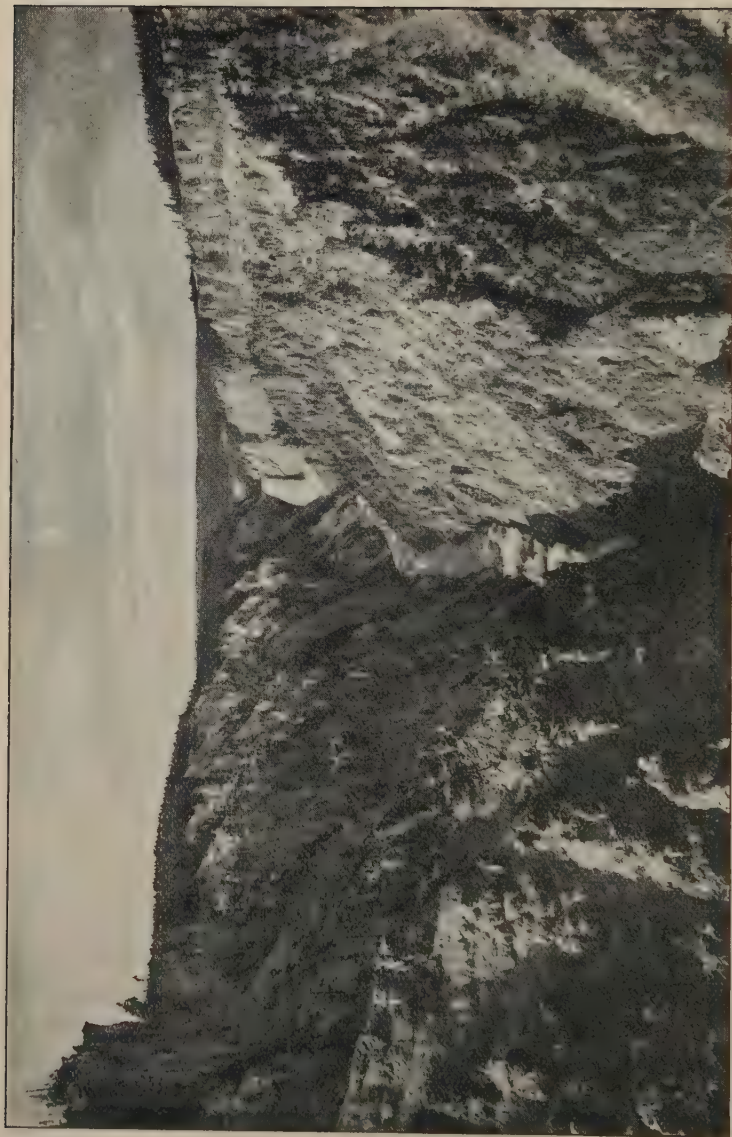
Thousands and thousands of years ago — no one can guess how long — strange things took place in the heart of the mountains on the east side of the Great Divide. In a basin partly encircled by granite walls, it happened in some way that the crust of the earth was broken, and a great rush of molten lava surged up from below. This was no ordinary eruption, but a series of mighty outbreaks



The great lava outflow in eastern Oregon. It is said that a man has to take several pairs of shoes if he intends to walk far over this rough surface.

of the earth's imprisoned forces. Again and again the great streams of lava poured over the whole mountain basin. They ran out over the sides, covering all the country around so deeply that it has never been uncovered since, and to this day more than four thousand square miles of land lie buried under it.

When the flow of lava ceased, the surface cooled, leaving a cold black plateau with steep and rugged sides — a hard, cold crust over a fiery and smoldering interior. Around the place where the lava had poured out, lay great ropes and rolls of the slowly hardening molten rock, looking like knots and tangles of gigantic reptiles. There were no trees, no grass, no life of any sort. Nothing could grow in the coarse black stone. The rivers and brooks had long since vanished as steam; the fishes were all dead and the birds had flown away. The whole region wore the desolation of death.



The Grand Canyon of the Yellowstone, showing the Yellowstone Falls in the distance. The rock walls are of disintegrated, or broken, lava of various shades of yellow, orange, and red.



But to let land go to waste is no part of Mother Nature's plan. So even this desolate corner of her domain was made ready for settlement. In winter she sifted snow over the cold black area, and in summer the snow melted into a multitude of brooks and springs. The brooks gradually wore paths and furrows in the lava bed, and the sand which they washed from one place they piled up in another. The winds blew the seeds of grasses about, and willows and aspens crept up the mountain sides. Then came the squirrels, scattering the nuts of the pine, until at last the slopes were no longer barren.

The brooks flowed over the surface of this strange place undisturbed by the fires beneath, and they were as clear and cold as mountain brooks should be. But rain and melted snow will never remain entirely on the surface. Some of it falls into cracks or joints or porous places in the rocks and makes its way underground. As the water collects, it forms underground streams or springs. In this lava region, however, a stream could not long run underground without coming into contact with the heated masses of rock.

Whenever the water worked its way downwards and met the hot rocks, it was changed into steam. Then the steam tore the earth open as it sought a way of escape. Sometimes it made a terrible commotion, like the shock of an earthquake; and sometimes the water would hiss and rise high in the air upon its escape, forming a geyser.

In some places the water came down little by little, lodging itself in many places at once. Then the hot rocks threw it back in many little honeycomb channels, and by the spreading of these channels the rocks were finally crumbled to pieces. Some of the hard lava was changed to white kaolin as soft and powdery as chalk. All this went on in hundreds of places and for thousands of years.

Then came the Glacial Period, or ice age, during which, in many parts of our country, snow and ice were piled up



mountain high. As the snow rose above the region of lava, it formed great rivers of ice, which moved down the ancient streamways. These slow-moving, gigantic ice rivers tore away huge blocks of lava and pushed them down the mountain sides. They scooped out deep valleys and ground down everything they touched. The winter of the ice age lasted a very long time, many thousands of years.

Then the seasons changed. The south winds blew, and the ice began to melt away. Torrents of water ran down across the lava bed cutting it into deep gorges and canyons. Some of this water trickled downwards deep into the ground, and was hurled back with violence, for all the snow waters in the world cannot put out the fires that rage in the depths of the earth.

In the depressions scooped out by the ice rivers were formed lakes of standing water. From the bottom of these lakes, the water found its way down to the hot lava below and was thrown back to the surface again, making in each case a fountain of scalding water in the icy lake.

The ice had killed all the plants in the region it covered and had driven off most of the animals. But when the snow was gone, the living creatures came back again. Grass and meadow flowers of a hundred kinds crept up from the south. The willow and aspen took their places again by the brookside, and the red fir and mountain pine covered the hills with their somber green. The birds came back. The wild goose honked and the winter wren caroled his bright song. The beaver cut his timber and worked at his dams. The thriftless porcupine destroyed a tree for every morning meal. The buffalo, the bear, and the elk each carried on his affairs in his own way, as did a host of lesser animals.

Ages passed. Finally there came a day when white men appeared in this old lava region; pioneers from the Atlantic states were moving westward. In the vanguard was the famous expedition of Lewis and Clark, which went overland



Cleopatra's Terrace, Mammoth Hot Springs, in the Yellowstone Park. These terraces were built up from mineral substances deposited by the water.

to the mouth of the Columbia River. A man named John Coulter was one of the hunters who accompanied this expedition. By chance, he discovered and followed the trail the Nez Percé Indians had blazed across the Great Divide that separates the Missouri waters from those of the Columbia. When he came back, he told the most wonderful tales of what he had seen near the head of the Missouri. There were cataracts of scalding water which shot straight up into the air. There were blue ponds of water hot enough to boil fish. There were hot springs that would turn trees into stone. The woods were full of holes from which issued streams of sulphur. There were deep canyons, their walls of ashes full of holes from which steam was constantly escaping. And there were springs which looked peaceful



Geysers, or "water volcanoes," in the Upper Geyser Basin of Yellowstone Park.

enough, but which at times exploded with a noise like a bursting bomb.

Everyone laughed at Coulter and his yarns, and the place he described was familiarly known as "Coulter's Hell." But although no one believed him, John Coulter had told the truth, and the truth could hardly have been exaggerated. When others followed him over the Nez Percé trail, came back, and told the same stories, people said they had been up to "Coulter's Hell" and had learned to lie.

But as years passed, many men who went that way reported that Coulter's tale was true, and finally in 1870 an expedition led by Washburn and Langford, made up of soldiers and Montana business men, officially explored the region. While still there, they determined to have it set apart "for the use and enjoyment of the people" forever, and the bill creating our first National Park was written in Helena, Montana, which then was still a territory. It was carried to Washington by the Montana delegate and was enthusiastically passed by Congress in 1872. Thus the wonderland of the Yellowstone became "a pleasuring ground for the people."

The first exploring party got the general bearings of the region and named many of the mountains. They reported so much of interest that the government sent out a company for a more systematic exploration. This resulted in a thorough scientific study of the region and greatly advanced the world's knowledge of volcanic action.

In the year 1888 Dr. Jordan was sent to the Yellowstone Park by the United States Fish Commissioner to look into the problem of the fishes of that region. He found no fishes in any stream above a fall, unless at the source of the stream there was an overflowing swamp through which fishes could pass in high water from one stream to another. When, after numerous adventures, he came back and told this story, men were sent out from Washington with nets and buckets. They gathered up young trout of four different kinds and



carried them to the rivers above the falls, where all the fishes had long ago been killed by the flow of molten rock material out of the earth. Now all the cold brooks and pools over the old lava beds, among the fairest streams on earth, are filled with trout.

Yellowstone Park has more and greater geysers than exist elsewhere in the world, because deep down under the ground the struggle between heat and water is still raging fiercely. Water trickles down through cracks from the surface until it reaches the heated region. There it becomes heated also, giving off steam and forcing upward the cooler water that lies near the surface. Then, after rising in the air and falling back to the ground, the water again seeps down to where the earth is hot and, as before, becomes heated to the boiling point. Again it rises as a fountain or geyser.

The most celebrated of the Yellowstone geysers — Old Faithful — played every sixty minutes until a few years ago, when the periods between its spoutings increased to seventy, and then eighty-five minutes. This shows that very, very slowly in this region the hidden lava is cooling off, and as years pass, the water has to have a little longer contact with the hot rock.

The Indians of northern Wyoming called the Yellowstone section the Roof of the World, and many are the legends they tell of the origin of its geysers and mud springs.

Long ago, they declare, in the wonderland that lies along the Roof of the World, there were many deer and elk and all the other animals that Indians like to eat. Because it was such splendid game land, the chief of the Nez Percés went there often to hunt, and always he came back with great stores of meat. One day, as he followed the chase, Wol-ka-li, the bad god who is the devil of the white men, came up from his place in the ground and saw the Indian.

“Get out of here!” he shouted angrily. “You are shooting deer and bison on land that belongs to me.”



"This place is mine," the chief replied. "Many moons I have followed the game trail here. Because I have been master of this country for so long, it belongs to me."

So they quarreled and wrangled, but could not settle the dispute. At last they decided to play the game of ho-ne-wah, a test of throwing sticks, which was a favorite sport among the Red Men. It was agreed that whoever won the game should be master of the hunting grounds.

A long time they matched their skill. Each played so well that it seemed there would be no winning, but at last the chief was victorious.

"The hunting grounds are mine," he shouted gleefully to Wol-ka-li. "It is you who must go away."

At these words Wol-ka-li became so angry that he frothed at the mouth. His body grew hot as fire, and because he was burning with anger he jumped into a pool to get cool. From one pool to another he darted, for it seemed that all the water in the world could not make him comfortable again. And in every pool where he bathed, the water became boiling hot. It was so hot that from some of the places it shot up in a mighty stream. That is why, according to the Red Man's idea, there are fountains of scalding water and many hot springs in Yellowstone Park. Wol-ka-li, in his rage over losing the game and his treasured hunting grounds, turned them all so hot that they have never cooled.

### III. PETRIFIED FORESTS

John Coulter told the truth about the wonderland at the headwaters of the Missouri when he said there were springs there that turned trees to stone. If you go a mile west of the place where the Lamar River joins the Yellowstone, you will see some tall stumps of trees which were petrified, or turned into stone, by inundations of hot water spreading from the lava.

When molten rock comes out of the earth, it takes a long, long time to cool, not a few days or weeks, but months and even years; and therefore streams that flow over newly made lava beds are hot instead of cool. Hot water, if it is a little alkaline, dissolves quartz and sand and carries it along; and when the water evaporates, it leaves deposits of quartz compounds marked with veins and stained in different colors, mostly red and orange. These colors come from salts of iron, for almost all rock contains iron in some form or other, and the hot water picks up some of this iron and mixes it with the dissolved quartz and sand.

Sometimes trees are buried below warm lava beds, or stand in the path of the overflow from hot springs, where hot water circulates about them for a long time. When this happens, little by little the heat of the water causes the cells and pores in the wood to fill up with mineral deposits which the waters carry with them. Little by little the woody substances are transformed from vegetable into mineral ones, a bit of mineral substance being substituted for every bit of wood. Slowly these mineral deposits harden, until finally a wooden log becomes changed into a chunk shaped like a log but made of mineral.

The petrified trees of Yellowstone Park have at some time stood in hot water. These trees were turned to stone only as high up as the water reached. The trunks above the water fell and rotted away, leaving petrified stumps of various sizes. In some places in the Yellowstone Park you can see the trees in the process of turning to stone, the upper part still standing, the base half petrified. This shows you how it all happens, for the stumps of these little larches and spruces are going the way of all the others.

The petrified forests of America are not confined to Yellowstone Park. There is a celebrated district in Arizona, near the village of Holbrook, where for several square miles the ground is covered with broken logs that long ago turned



Broken tree trunks that have turned to stone, Petrified Forest, Arizona.

into stone. The trees became buried more or less by showers of ash from vast volcanic eruptions. Sometimes the trees were buried standing; sometimes they were prone. Hot alkaline waters seeped through the ash, dissolved silica therefrom, and slowly deposited it, replacing the wood of the trees. This petrified wood is hard and heavy and takes a fine polish, if one chooses to rub it with something harder than quartz.

Near Tonopah, Nevada, there is a dried-up lake known as Esmeralda. It is now filled with soft mud in which are remains of animals and fishes that were there when its waters disappeared. A short time ago, a man living in Tonopah wrote to the senior author of this book that he had found a fossil monster. He sent it down to him at Stanford Uni-

versity, but it proved to be not a monster at all. An examination showed it to be part of the trunk of some evergreen tree with very thick bark and angular branches which had fallen into the mud. There it had become slowly saturated with mineral substance and finally turned to stone.

There are petrified trees in California also. In Napa County, some forty miles north of San Francisco, you will find a valley with lava masses on either side. On the western rim of this valley is a field once covered with hot water from the lava. Here also is wood that has been turned into stone.

#### IV. THE VALLEY OF TEN THOUSAND SMOKES

Among the many volcanoes in Alaska, there is one, Mount Katmai, that is a story in itself, and in recent years the world has been talking about it a great deal.

Mount Katmai is near the base of Alaska Peninsula, across Shelikof Strait from the island of Kodiak. It was a peak to which geologists gave little attention, because for a long time there was no evidence of activity about it, and so it was not even mentioned among the mountains of this region of which surprising things might be expected. But during the month of June, 1912, this seemingly lifeless peak broke into violent eruption. The force of the pent-up stream within tore a great hole in the side of the mountain, and through this crater came an enormous mass of ashes and lava. Scientists say that if all this exploded stuff were to be heaped up in one place, it would make a pile two miles high, two miles broad, and a mile and a half long. It was deposited to a depth averaging six or seven feet over a section of country as large as the state of Connecticut. Trees and plants were killed. In fact, vegetation of every kind was destroyed. Doubtless thousands of animals lost their lives too — bears, foxes, wolverines, and others that frequented the region.





Volcanic ashes from Katmai covering spruce trees on Kodiak Island.

So far as we know, no human lives were lost. Most of the natives of the little village of Katmai, twenty-five miles distant from the scene of the eruption, were away fishing and thus escaped death, but their village was entirely destroyed. Several of the natives had not yet left the little town when the eruption began, but they escaped by putting out to sea. The stories they told about the terrifying sights they witnessed, and the awful sounds they heard — the flames, the smoke, the thunder and groans within the earth — frightened the other villagers so much that none of them went back. They founded a new settlement some



miles away, and there they still live and tell amazing stories about what happened at the great mountain.

The ashes poured forth from Mount Katmai not only covered the mainland for great distances around the peak, but were scattered a hundred miles away over the island of Kodiak. It killed plants and trees there and transformed what had been a fertile region into a desert waste. A year after the eruption, when this island was visited by Robert F. Griggs, an American scientist, it was such a forlorn-looking stretch of ashy sand that it was hard to believe that vegetation would ever be seen there again.

Two years later Professor Griggs went back. He was amazed to find that barren waste as green as a garden. Although it lies so far north, Kodiak Island has a milder climate than that of Boston, because the Japan Current flows near its shores, and plants of milder regions thrive there. The coarse northern grass was head high. There were quantities of wild berries of most delightful flavor. The volcanic ash had proved to be both a curse and a blessing. Although it killed the vegetation when it rained over the island at the time of the eruption, it was a fine fertilizer and made this a more luxuriant region than it had ever been before.

A very different story is that of Katmai hamlet on the mainland and the region for miles around the great mountain. It is a waste today, just as it was immediately after the eruption. There the ashes and lava were piled so high that the plants struggling upwards from the old roots could not get through. The only growing thing to be seen anywhere near the base of the volcano is the field horsetail, a coarse weed nobody cares anything about. It thrives there only because it is so hardy that it can hold its own almost anywhere.

Mount Katmai is not the only peak on Alaska Peninsula that showed signs of life in 1912 and has continued to show

them since. Until scientists had carefully examined the craters of both Mageik and Katmai, they were not certain which one was responsible for the great damage to the country around them. But the size of the hole in Katmai, as well as several other things, told the story. Mageik continues to smoke; so we know that it is far from quiet. Numerous peaks around it also smoke, for Alaska Peninsula is made up almost entirely of a mountain range and, since 1912, the world has found out that it is a range that is very much alive. In fact, so many signs of activity have been seen in this vicinity, so many gray clouds were constantly rising from smoking peaks, that the region around the base of Katmai came to be called the Valley of Ten Thousand Smokes.

## V. HAWAII AND SAMOA

Hawaii and Samoa, two islands of the Pacific, are formed around a series of volcanoes and are composed entirely of lava.

The Hawaiian Islands (no longer known as Sandwich Islands) lie not too far from the center of the great ocean, and as nearly all the steamships bound for Asia or Australia stop there for the day, the people of the islands speak fondly of their home as "the Crossroads of the Pacific." But in their political relations as well as their geography, we must regard them as an outlying part of North America, and a wonderfully beautiful part it is, with florid tropical vegetation, high mountains and sharp cliffs, most of them once part of the rims of huge volcanoes.

There are five main islands besides some smaller ones, each the product of gigantic eruptions. To the west lies Kauai, which is much the oldest. Its bold surface has been scored by rain into deep gorges, while the mass of crushed rock has made its valleys very rich. Oahu stands next in



A portion of the crater of Kilauea, Hawaii. The photograph was taken by Mr. H. J. Brown at night, by the light of the molten lava, which gives off constantly changing lights of many varied and beautiful colors. The whitish parts represent areas of glowing bright-red lava. The irregular block or hill in the center is a "floating island" of solidified lava; and around this island the molten lava is circulating in a steady stream or whirlpool.

age and in position. Its capital city of Honolulu, having nearly 100,000 inhabitants and great commercial interests, occupies a site of unrivaled beauty.

Molokai and Maui come next in line, famous like Oahu for sugar cane and pineapples. Maui is noted also for the immense extinct crater of Haleakalá.

The largest island, Hawaii, to the south, is much younger than the others. It has two immense mountain elevations — Mauna Kea, now extinct, and its sister, Mauna Loa, still subject to violent outbreaks from time to time. Its snow-clad summit has ejected enormous overflows of lava, which on the west side reach the sea. On entering the water, the

cooled outer crust forms a tunnel, through which the red-hot interior liquid rushes.

On the south flank of Mauna Loa, far below the summit, lies the crater of Kilauea, a deep basin nearly three miles across, having vertical walls five hundred to nine hundred feet high. The floor of this huge basin is covered with hardened tangled ropes of lava, the outflow of centuries. Within this basin is the secondary crater called Halemaumau, still active. At times it is a deep vent a few rods across, densely filled with smoke. At other times it appears as a boiling caldron of red-hot lava. This has twice overflowed in recent years, forming a fiery pond of fifteen to twenty acres. About Kilauea are amazing forests of great tree ferns, with long feathery fronds as delicate as those of a wood fern of the North.

Because these volcanic regions are very strange and interesting, the craters of Haleakalá, Mauna Loa, and Kilauea were combined to form the Hawaiian National Park in 1916, the only National Park which our government has established overseas.

Still farther south, on the other side of the equator, is a little green island where the people proudly sign themselves as from "Tutuila, U. S. A." Tutuila is one of the islands of Samoa, a small group which includes Upolu, Savaii, and a few others. Tutuila has the finest harbor in all the South Seas, known as Pago Pago, absolutely landlocked, for it is an ancient volcanic crater several miles across, into which the sea has broken through the low eastern side.

Tutuila is just one of the tiny islands which by thousands dot the warm ocean between Java and the Marquesas. Like the others, it is filled with joyous people as free from curiosity as to what happens in Paris or New York as the folks of Vesta or Ceres in the starry heavens — if there are any folks there — are careless of the doings on their planetary neighbors, Mars and Jupiter.

## CHAPTER FOUR

### A STORY OF GLACIERS

#### I. THE ORIGIN OF GLACIERS

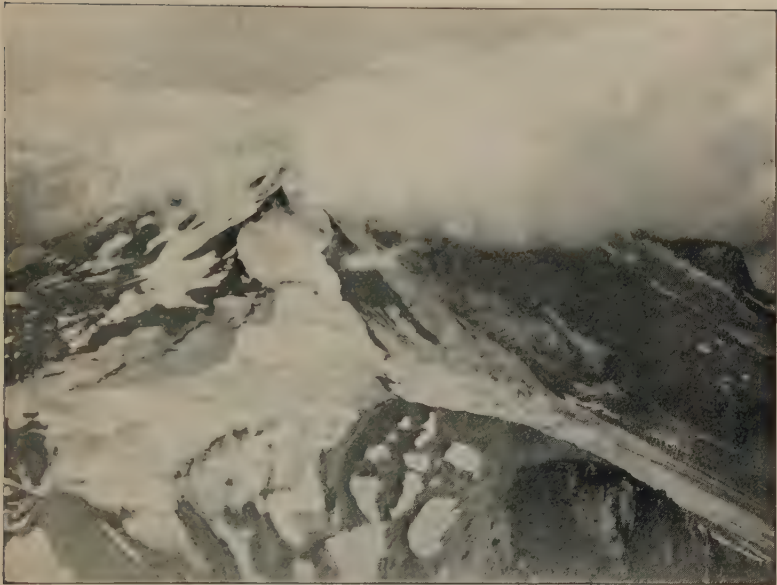
IN the long history of the earth there have been several alterations of temperature, ages of widespread heat and ice ages, when a winter of the most extreme cold settled over the valleys and mountains. The last of these ice ages we know best, and it continued for thousands and thousands of years. Some very amazing things happened during those frozen centuries; but before we can understand exactly what occurred, we must take a look at the snowy places in the mountains of today.

On mountain summits that are high enough, snow falls at all times of the year. This snow wedges itself into every crevice and cranny. It melts a little on sunny days and freezes with a hard crust at night. The lower layers of this great mass of snow by pressure become compacted into ice. This mass of ice flows into depressions or gorges on the mountain side and forms a glacier, a slow-sliding river of ice. From the lower end of the glacier issues a torrent of light gray water, turbid with the rock particles it has scraped off. The glacier moves by its weight, and even on level ground it may be pushed on by the weight of ice piled up behind it.

If the slope of the mountain is gradual, the glacier goes so slowly we cannot see any motion, and only exact scientific instruments mark the rate of progress. Where the mountain side is steep, the motion is more rapid. Some glaciers move only a foot or less in a day; others move even fifty or sixty feet in a day. When a snow or ice mass breaks loose, it becomes an avalanche.

Very often deep cracks run through or across a glacier. These are known as crevasses. Some crevasses are very narrow and some are broad, wide enough to swallow up a

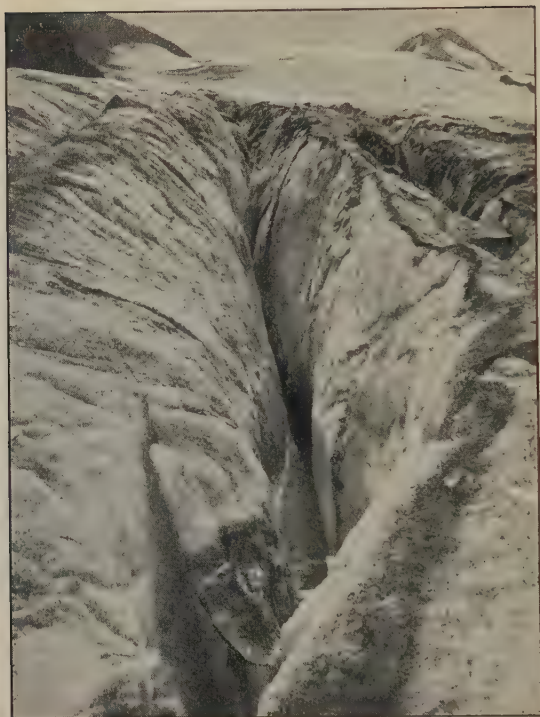




Airplane view of glaciers on the sides of Mount Adams in the state of Washington.  
On all mountains having perpetual snow fields, there are one or more glaciers.

man, or even many men. In the Alps of Switzerland, in the Himalayas, and in the Andes — in fact, wherever mountains are so high that glaciers form upon them — many a climber has lost his life by falling into a crevasse.

Usually a glacier runs in a deep valley between cliffs, and it makes the valley wider and deeper. Pieces of rock and even large boulders break off from the sides of the cliffs and fall upon the glacier. Sometimes these fallen rocks ride along on top of the ice. When they do this, they keep their original form because there is no friction to wear off the corners. But when they fall into a crevasse, they are rolled over and over. Rocks that travel at the sides of a glacier or in a crevasse become worn down and rounded by grinding against one another or against the sides or bottom of the valley. When we see boulders today, we can tell some-



A crevasse in a glacier below one of the peaks of the Three Sisters in Oregon.

thing about their travels long ago in the ice ages. Boulders that have ridden on top of a glacier are angular and rough, while those that traveled at the bottom or sides of a glacier have been worn down and rounded.

By and by, as a glacier travels, it moves down into the warm valleys. There it melts, and all the boulders and rock bits it has carried are deposited in piles or heaps. These piles are called moraines. Sometimes they are just low heaps of earth; sometimes they form high hills and banks. Many of the hills in the eastern part of our country were made in this way ages ago, by the piling up of rocks and soil that a river of ice bore along.

A glacier does many things besides piling up hills. It scoops and digs as it goes, like a plow in a field. When it strikes a mass of softer rock, it carries it away, leaving a hole or depression that fills with water and becomes a lake. Sometimes a glacier makes a lake bed, not by scooping out the earth, but by piling walls of moraine across a river bed, damming it up as boys dam up a brook with rocks and sand.

In the very cold regions, such as Greenland and the South Pole, the snow that falls at all times of the year piles itself on the land to a very great depth, forming continental glaciers. Such ice sheets covering hill and valley are shoved along on level ground by the impact of the great mass behind.

During the great ice period of thousands of years ago, the glaciers spread over vast areas in North America and Europe, even as they now do in Greenland. They carried boulders, tore up the soil, moved it south, scooped out lakes, piled up moraines, and did everything glaciers are



A huge granite boulder that was carried by the Continental Glacier from a point several miles farther north and dropped on this hilltop.



Low hills in New York that are the remains of a moraine deposited by the Continental Glacier.

doing today in Greenland — and a great deal more, because there was more ice then and a far greater amount of it was pressing from north to south.

A mighty frozen mass spread over the eastern and northern part of the area that is now the United States, down nearly to the present site of Trenton and as far west as St. Louis, thence northwest to the headwaters of the Missouri River. Scientists call it the Great Continental Glacier. Over the extensive area which this ice sheet covered, it left boulders, called erratics or wanderers. These boulders with smaller fragments made the soil of crushed rock that is known as drift. With the exception of one locality, all the region north of the line reached by this great glacier is drift soil.

In the southwest corner of Wisconsin, and extending over into the neighboring parts of Illinois, Iowa, and Minnesota, there is a district which the ice never covered. This section is called the Driftless Region. Here hills to the northward must have split the shallow ice sheet, leaving a sort of island within the frozen mass, and here you will find



no erratic boulders. Anyone who lives in that region will be interested in noticing the difference between the soil of the Driftless Region and that of most of the country around it, where drift from the north is buried under black prairie loam. In the Driftless Region the soil is formed by decomposition of rocks in place (that is, where they stand); in the other sections the soil is brought down from farther north. Drift soil, being well mixed, is on the whole richer than soil in place.

The largest glacier that we now have in the United States comes down from Mount St. Elias in Alaska. It is known as Malaspina Glacier, and is forty miles wide above the place where it breaks into the sea. Our next largest, Muir Glacier, comes down into Glacier Bay near Mount Fairweather. Where it reaches the bay, the wall of blue ice is more than a mile wide and some five hundred feet high.



A mass of granite, rounded and polished by a moving glacier. Note the parallel lines cut into the rock by the ice.





Where Muir Glacier meets the sea. It is at this point that icebergs form in summer by breaking off from the main mass of ice and tumbling into the sea.

It was on this glacier that the famous geologist, John Muir, took his dog Stickeen, and you will find it interesting to read in Muir's works what the dog thought and did while wandering over the cold and broken surface of the ice.

When the ends of a glacier break off into the sea, they form icebergs. The senior author of this book once saw Captain Moser of the *Albatross* put a lasso around an iceberg in Alaska and haul it aboard ship to fill the ice chest. But icebergs are not generally so small as that one was. Some icebergs are hundreds of feet high and many hundreds of feet through, and only about one twelfth of the great frozen mass shows above the surface of the sea. The ice is a little lighter than water, and it displaces its own weight of water. In summer icebergs come down from Alaska, but they do not come far and they are never very large.

Icebergs that break off from the glaciers of Greenland and the western coast of Baffin Bay drift southward toward

the shore of Newfoundland. These icebergs melt as they go south and finally disappear when they come near the warm Gulf Stream. But on their way they sometimes float across the northern steamship lanes of the Atlantic Ocean. As the atmosphere around them is often densely foggy, they are a very great danger to navigation. It was only a few years ago that the *Titanic*, then the largest vessel afloat, set out on her maiden voyage from Southampton, England, to New York. The passengers were delighted to have the privilege of traveling on this swift and luxurious liner, and eagerly watched the efforts of the captain to pilot her across the sea with a fine record for speed. But off the coast of Newfoundland the great ship struck an iceberg, which tore a hole in her side and sent her to the bottom of the ocean with most of her passengers.

## II. THE WORK OF THE GREAT CONTINENTAL GLACIER

### PONDS THAT CHANGED TO SWAMPS

All over the region covered ages ago by the Great Continental Glacier may be found many ponds and small swamps that once were ponds. Some of these were scooped out by the ice, and some were made when walls of moraine were piled across river beds. There are vastly more swamps than ponds in the drift region, because most of the ponds have gradually filled up with vegetation.

The story of how the ponds changed into swamps is very interesting. In northern regions a tall moss, called sphagnum, grows upright in the water near the shores of ponds. Cranberry vines and swamp laurels grow there too. Both these plants have long, wiry, rooting stems, which creep in among the sphagnum. By and by a tough, floating carpet is formed over the greater part of the pond, the moss being held in a firm grip by the entangled vines. The

lower end or "root" of the sphagnum plant drops to the bottom of the pond. This process is repeated year after year as other sphagnum makes its way along the surface of the water until finally the pond is filled solidly through. In time, this accumulated vegetation forms a black mass known as peat, the cleanest forms of peat being somewhat like coal and valued as fuel.

When peat is made up of pure sphagnum, it is excellent fuel. Often, however, clay washes down into the pond, and coarse grass and sedges creep in, sometimes crowding out the moss. A swamp thus filled contains black muck that is hardly worth taking as fuel, although it is formed in much the same way as peat. In the ponds of Norway and Ireland, where there is much sphagnum, peat is largely produced. In the United States most of the swamps, except in the northern region, develop only black muck, because the deposits that fill them are made up chiefly of sedges, which have not the fuel value of the moss.

#### THE GREAT LAKES

Many of our lakes were made in the ice ages, and the glaciers have affected them in various ways. The Great Lakes, the majestic bodies of water lying along the boundary between the United States and Canada, were in part formed by glaciers, which deepened the ancient valleys and river beds and dammed them up with walls of moraine.

The largest of these lakes is Superior. When the great ice sheet came down from the north, it filled up two valleys separated by a high ridge of land, which we call the peninsula of Keweenaw. One part of this ice moved southward to the west of Keweenaw and the other part to the east, digging still deeper into the valley. Consequently the lake on both sides of Keweenaw is very deep, over nine hundred feet.



A glacier-made lake in the Sierras. In the great ice age a glacier filled this little valley and dug out a basin, which later became a lake. As time went on, the stream flowing into the lake brought sand and clay from the mountain sides and partially filled the little lake basin.

An interesting fact about ice-made lakes is that in some cases you can tell from their shape whether the valleys that hold them extended in the same direction in which the glacier moved, or at right angles to it. Lakes formed from valleys that lay in the same direction as the flow of the glacier are usually long and narrow. Those that extended at right angles and were crossed by the flow are, in comparison, broad and irregular in shape.

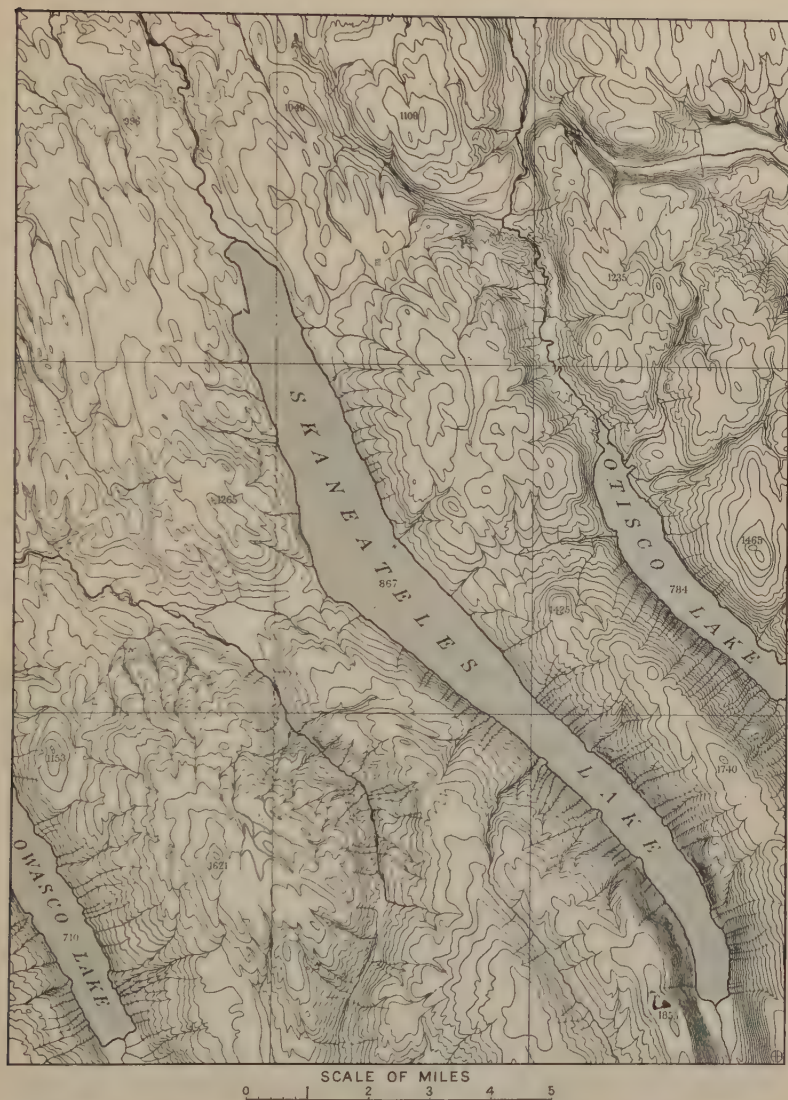
Lake Michigan is almost as deep as Superior, and so is Lake Huron. But the east side of Lake Huron, spreading eastward and forming Georgian Bay, is shallow. In many places the hills, though polished down by the moving glacier, remained as rounded knobs of granite. That is how Georgian





Map showing the multitude of lakes in a region (central Minnesota) once covered by the great continental glacier. Irregular depressions in the moraine deposited by the glacier became the beds of lakes.





Map of a portion of the Finger Lake region of New York, showing the character of glacial lakes in an area where the drainage was parallel with the movement of the great glacier. The ice deepened the existing valleys and then dammed up one end when it retreated. The fine lines, called contours, show the height of the land. Where the lines are close together, it shows that at this point the land is very steep.

Bay, the shallow part of Lake Huron, came to be filled with islands. It is said there are thirty thousand of these islands, but although the authors of this book have been among them, they never have counted more than a few hundred.

The original basin of Lake Ontario, formed by a small stream, lay partly east and west to the glacial flow, and the frozen mass moved across it without digging as deeply as in the upper lakes. Therefore this lake is not nearly so deep as Lake Michigan and Lake Huron.

The valley that became Lake Erie lay crosswise to the current of the ice, and it is relatively shallow. For this reason it is the greatest fishpond in the world, because the food of fishes, whether it is plant or animal life, grows best in shallow water. From one end to the other, Lake Erie is filled with fish food.

#### THE FINGER LAKES

South of Lake Ontario, in the central part of the state of New York, lie the great series of Finger Lakes, fourteen in number — all, except one, long, slender, gracefully shaped bodies of water that are widely famed for their beauty. There is Silver Lake, farthest west, then Conesus, Hemlock, Canadice, Honeoye, Canandaigua, Keuka, and Seneca. Next comes Cayuga, largest of them all, and after it Owasco, Skaneateles, Otisco, Onondaga, and broad and shallow Oneida. Once these valleys were occupied by rivers, but the ice came into them and deepened the channels and dammed up the outlets with walls of moraine. Therefore, as the frozen mass melted, it left deep lakes in these old valleys.

The Indians said that every one of these lakes was a footprint of the Great Spirit, a depression which he made as he wandered over this region long ago. And each footprint he filled with water so that there should be plenty of fishing places and hunger should never smite the tribes who dwelt in those fair valleys. But the white man knows better.

He has found out that they were formed by the same sea of ice that molded the Great Lakes and many others we know.

THE THUNDERING WATER — THE GREAT FALLS OF  
NIAGARA

One very remarkable operation of the Great Continental Glacier was on the Niagara River, through which the overflow from Lake Erie goes to Lake Ontario. In this river, near the city of Buffalo, is one of the most majestic cataracts the world knows, Niagara Falls.

Here there were two plains of different levels. Lake Erie lies on the upper, and Lake Ontario on the lower of these plains, and where the higher plain drops to the lower one are the bluffs of Lewiston, some three hundred feet high and formed of very hard limestone with soft shale beneath. When the Niagara stream began to flow long, long ago, it tumbled over these bluffs and made a waterfall, which has since undergone remarkable changes.

The waterfall remained vertical because the rocks on top were harder than those below, and they endured after the soft edges of the rocks underneath had been ground away. This left an almost perpendicular cliff instead of a sloping surface, as there would have been if the softer portions had been on top. Had the top layer of the Lewiston bluffs not been so hard, a rapid instead of a waterfall would have been formed there.

Now comes the most fascinating chapter in this geological story. As the winter settled over North America and glaciers began their work, the ice that came down from the north blocked the narrow valley now known as St. David's Glen, through which the Niagara had flowed. The piled-up material left by the glacier afterward prevented the river from getting through its old bed, so it turned eastward at a right angle from its old course and cut a new channel.



Airplane view of Niagara Falls. The American Falls are on the left, and the Horseshoe (Canadian) Falls are on the right. The *Maid of the Mist* shows as a tiny black spot near the Canadian Falls. The boundary line between Canada and the United States runs between the two falls and then down the middle of the river.



As it changed its channel, it changed also the location of the cataract, forming a new fall where it came to the edge of the bluffs, and, in time, at the point of turning it formed a great whirlpool.

The cataract of Niagara has been cutting its way backward ever since the ice period. At the end of this period it was on the edge of the bluffs between Lewiston and Queens-town. Now it is about seven miles farther south.

The moving of the falls is due to that hard surface limestone which helped to make this great vertical waterfall in the beginning. The wear of the water has little effect on the hard limestone; but the lower rock is softer and is cut away by the never-ceasing flow of the stream and the pounding of the fall. After a time, there is nothing left underneath to support the hard top portion. It drops, and the cataract moves a little farther back, remaining there until again the lower portions have been carried away by the stream. Then the surface rock drops again, and again the cataract travels a little farther up the river. This has been going on throughout the centuries until now we have some seven miles of gorge with vertical walls before we come to the present waterfall. Here the river is split by an island, Goat Island, which divides the cataract into two sections, the Horseshoe Falls on the Canadian side of the river, a curved white wall of water one hundred and sixty feet high, and the American Falls, shallower and some fourteen feet higher.

The tribes living near the falls of Niagara called it the Thundering Water, and believed its roar was the voice of a god dwelling under its whirlpool, whose anger would be a terrible thing if they should ever draw it down upon them. So once each year they made a sacrifice in order that they might live in peace with him, and this celebration was the most solemn and sacred one known to the Iroquois Indians. A young girl decorated with fruits and flowers went down the



river in a canoe, over the cataract, and into the whirlpool below. The Iroquois maidens all strove for the honor of being chosen to make this death journey, because they believed that whoever made it would be an object of special favor in the Happy Hunting Grounds.

There is a legend that once a girl begged to be permitted to make the sacrifice, but because she was the promised bride of a brave who would become a sachem, the chiefs of her people chose another maid. The wedding morning came and the Indians began the wrestling matches and marriage games with which they always celebrated such events, when suddenly word went through the village that the bride had disappeared. Through the forest and along the stream they sought her. All at once a cry of dismay arose, for an old medicine man saw her drifting toward the thundering falls.

The entire village started in pursuit, but the girl plied the paddles with such swift, powerful strokes they could not overtake her.

"I will not come back," she shouted, as the boat dropped over the cataract, "for I go to dwell with the Great Spirit in the Happy Hunting Grounds."

The Indians believed that, because of the devotion of this girl, the god of the cataract placed her in a cavern under the falls, where she might be near enough to her people to be of service to them in times of need. They called her the Maid of the Mist, and said that whenever pestilence visited that region, the god lifted her to the shore so that she could tell her dear ones how to escape it; and if famine strode through the villages, she told where fish, game, and acorns might be found. Now, a passenger boat called *Maid of the Mist* plies on the river below the falls, its name perpetuating the legend of the Iroquois girl.

On the plain below the bluffs that make the falls of Niagara is a low ridge of sand and gravel running eastward through

several counties. At Lewiston it is about one hundred and forty feet above Lake Ontario; farther eastward it is from two hundred to three hundred feet higher than the water. It is part of the beach of a lake which once covered the land where Lake Ontario now lies, and which geologists know as Lake Iroquois. Ever since there have been white settlers in New York, this old beach has been used as a highway, and it is called the Ridge Road. Dr. Jordan recalls, as one of the great events of his boyhood, a trip he took over this road in a carriage with his father. But in those days he did not know that the sand and gravel that make the roadbed were piled there by the waters of an ancient lake.

LAKES OF NEW ENGLAND; LAKES CHAMPLAIN AND  
GEORGE

Glacier-made lakes are scattered all over New England. In the state of Maine there are hundreds of them, so many that the Indians who lived in this region called it the Land of Sky-blue Water. Largest of all is Moosehead, celebrated for its beauty, and noted also as being in the region where the king of American forest creatures, the moose, used to roam in all his wild freedom. There, too, is Caribou Lake, called after the fleet-footed American reindeer which frequented its shores and waters during the summertime. There are the Rangeley Lakes, in which the trout delight and fishermen also; and there is Sebago, south of the Rangeleys, the haunt of land-locked salmon. Besides these are Grand Lake, Eagle Lake, and a number of others, all within the boundaries of Maine and all molded by the ice.

In New Hampshire lies a large body of water called Winnepesaukee, an Indian name which means 'Smile of the Great Spirit. Lake Winnepesaukee is fed by clear, swift streams formed by the rain and snowfall in the White Mountains. Its waters flow into the Winnepesaukee River, which



Echo Lake, looking toward Franconia Notch, White Mountains.

in turn helps to form the Merrimac, a stream that moves through a storied country.

In Vermont and Canada lies the ice-made Lake Memphremagog, long, narrow, and very deep, with hilly shores. The poet Whittier in "Snow-Bound" tells how, during the time the blizzard kept them all indoors, their father told of hunting and fishing expeditions at this lake, in his youth :

Our father rode again his ride  
On Memphremagog's wooded side,  
Sat down again to moose and sump  
In trapper hut and Indian camp.

Not far from Memphremagog, among the green knolls of Vermont, is Willoughby, a glacier-formed lake celebrated for the clearness of its waters and the enormous boulders

that lie deep in its bed, looking like fabulous monsters when seen from the edge of a boat. To the geologist, these rock masses tell a story of days when a glacier carried them down from the north and left them behind as it melted. But to the Indians, they were once quarrelsome chiefs, changed to stone by the angry Manitou, as they called the Great Spirit. They say that far back in the beginning of things these chiefs were forever disputing about their possessions. One day as they stood quarreling on the water's brink, the Great Spirit turned them all to stone. Then he dropped them to the bottom, and made the water so clear that whoever looked down into it might see what comes of being greedy.

Partly in Vermont and partly in New York is Lake Champlain, one of the most beautiful bodies of water in the world, and, like Memphremagog, long, narrow, and very deep. It takes its name from Samuel de Champlain, the French pathfinder who discovered it while pushing through to the country of the Hurons. He sailed its entire length, charted its coves and islands, and went with the trembling Indians as close as they would venture to a curious, craggy formation on one of its banks that is still called Great Spirit Rock. Here was a boulder worn by glacial action into exactly the form of a serpent, and the Red Men feared it much. Regularly they held religious dances within sight of it, during which they begged the sacred serpent to carry a message of their devotion to the Manitou. A snake seems a curious messenger, but all primitive peoples hold snakes in reverence and awe; and to see a massive stone serpent gazing down over their fishing and canoeing place was enough to make the tribes around Lake Champlain very fearful of Great Spirit Rock.

Some interesting chapters of the Revolutionary War and the War of 1812 were enacted on and beside Lake Champlain. Here stood Fort Ticonderoga and Crown Point also, where Ethan Allen and General Warner won



Copyright by Hamilton Maxwell  
Lake George, or the "Horicon," as the Indians called it. Airplane view showing the Narrows.



victories for the colonists. Here was waged the famous battle of Lake Champlain, in which the American fleet overcame the British; while at the same time at Plattsburg on the New York side a land battle resulted in victory for the Americans.

In the fight on Lake Champlain and in the land encounters at Fort Ticonderoga and elsewhere, great courage was shown on both sides, and there were many deeds of heroism. But we should not forget that the War of 1812 was needless and settled nothing, while stirring up hatred which it took years to abate.

Yet it had one noble result, the resolve that England and America should never go to war again. By a treaty called the Rush-Bagot Convention, it was agreed that on the Great Lakes and the rest of the Canadian boundary there should be no warships, fortresses, or soldiers. And so far, for more than a hundred years, we have had neither war nor rumors of war along the unguarded border, which is fifty-four hundred miles long, if we include Alaska. Meanwhile, Canada, one in blood with both the United States and Great Britain, is the best guarantee of friendliness between the two nations.

History has been made also around Lake George, a glacial lake just to the south and west of Lake Champlain, and connected with it by Ticonderoga Creek. Lake George is famed in the stories of James Fenimore Cooper as Horicon, by which name the Indians knew it. In the old colonial times the country surrounding it was a great war trail. Three small forts stood upon its banks — Forts William Henry, George, and Gage — and each one of these witnessed many exciting events. On the shore of this lake was fought the famous Revolutionary battle of Lake George. A few years ago the state of New York purchased this battleground and made it into a park, which now bears the name of Battle Park.

## LAKE OF THE WOODS AND THE NORTHWEST ANGLE

Running back from Lake Superior are a number of excavations scooped out by glaciers during the ice ages. The farthest west of these is a large depression called Rainy Lake.

The water from Rainy Lake flows westward and plunges over a cliff, making a beautiful cataract known as International Falls. Then down through woods of white birch and over swift rapids it goes, and spreads out into a larger lake entirely surrounded by white birch. This is called Lake of the Woods, a body of water that lies chiefly in Canada, but belongs partly to the United States. It is the largest of a group of lakes that extend throughout the state of Minnesota. Similar lakes run through Canada almost to the Arctic Circle. Like Maine, Minnesota has so many lakes that it is "a land of sky-blue water," and every one of them was molded by glaciers that swept down from the north ages ago.

The northern part of Lake of the Woods was once a group of hills, hundreds of little elevations of hard granite, over which the glaciers slipped during the earth's long winter. They excavated all the soft places, making what is now the lake bed. Then, as water filled the depressions, the hillocks stood above the surface as little islands. There are so many of these little islands that more than half of Lake of the Woods looks like a dense aspen and birch forest, through which the passage of a steamer seems impossible; but one can sail here for hours, winding in and out among the islands.

Below the outlet of Lake of the Woods is a rapid or waterfall that was much frequented by muskrats in early days. This locality was long called Rat Portage because of the muskrats, and because here the Indians and early French explorers had to make a portage; that is, they had to carry their canoes by land around the falls.

If you look on a map, you will see near Lake of the Woods a little triangle which cuts into Canada. This is the Northwest Angle, and it came about in this way. There was a long dispute over the boundary between the United States and Canada. When finally the line between the two countries was agreed upon, it was decided that it should run through a section of Lake Superior and northwest through a chain of lakes until it struck Rainy Lake. From there it was to go along Rainy River to Lake of the Woods, then continue straight across to the most western point of that lake. From this point it was to move north or south — no one knew which way it would be — to the parallel of 49 degrees. Then it was to extend directly west until it came to Puget Sound, down through the middle of the Strait of Juan de Fuca, and around Vancouver Island to the Pacific, as you can see from the map on page 230.

Now it happened that the parallel of 49 degrees measured on the maps several miles south of the place that was located as the western point of Lake of the Woods, so a little section of shore inhabited chiefly by fishermen was cut off from Canada and turned over to the United States. Where the boundary line crosses Puget Sound, the same thing happened. Here the parallel of 49 degrees took off part of the promontory known as Point Roberts, and that cape is held by fishermen from the United States, who have excellent success in catching salmon there. They intercept, or head off, these fish as they go on their way northward from Puget Sound to Fraser River, in the sources of which nearly all the salmon of this region deposit their spawn.

#### THE LAKES OF CANADA

Almost every part of Canada is marked by glacial lakes, some of which are almost as large as the Great Lakes. Great Slave Lake, receiving the waters of numerous rivers, feeds the Mackenzie River, the largest stream wholly in Canada,

which flows to the Arctic Ocean. Another huge Canadian lake, Great Bear Lake, also sends its waters to feed the Mackenzie River. Lake Winnipeg, almost as large as Great Slave Lake, receives the waters of the Saskatchewan, Red River of the North, and Winnipeg River. The flood from these streams, going down into the lake, finally moves on to Hudson Bay through the Nelson River, which is the outlet of Lake Winnipeg. In eastern and southern Canada are still other lakes. All over this great northern land, in fact, we find lakes molded by glaciers of long ago and giving much beauty to British North America.

### III. THE WORK OF GLACIERS IN WESTERN AMERICA

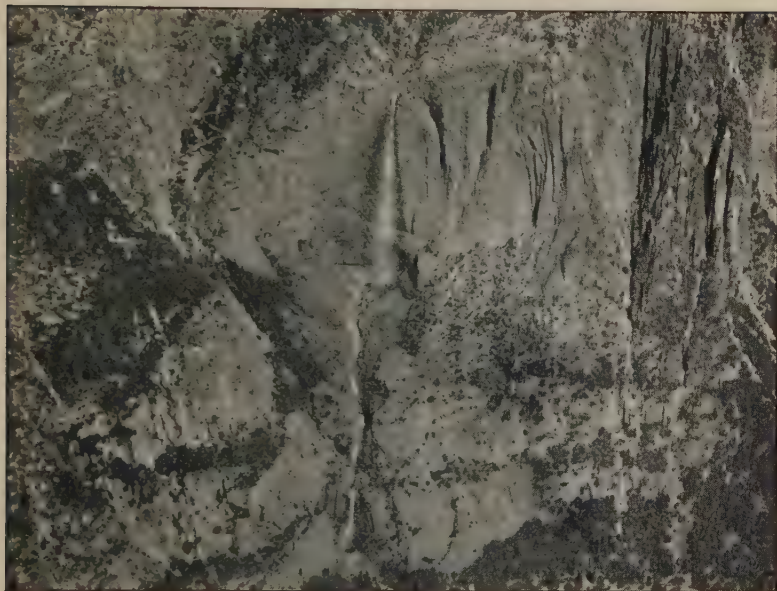
#### YOSEMITE, VALLEY OF MARVELS

While the Great Continental Glacier was sweeping over the northeastern part of our country, glaciers in the high mountains were at work in many other sections, sawing and carving and doing all the various things that took place during the long period of time that made up the ice ages. Among the Rockies, the Sierras, and the Cascades, are numerous valleys, cliffs, and gorges where we find the remains of work done during those frozen centuries.

Most stupendous of all is the wonderland that is called Yosemite. This valley lies in the heart of the Sierras in California, and is a deep gorge seven miles long through granite mountains. The walls are in some places perpendicular, and where rivers plunge over them we find waterfalls of surpassing beauty. Yosemite Falls in two leaps drops some twenty-five hundred feet. Not far away is the Nevada Fall of the Merced River, seven hundred feet, which is in form one of the most perfect cataracts in America. Other cascades of this incomparable valley are Vernal Falls, Bridal Veil Falls, Chinquapin Falls, and Illouette Falls.

Over the Nevada Fall flows the main current of the Merced





How Yosemite Falls, the highest waterfall in the world, looks from an airplane. The total drop from the crest to the river below is about half a mile. This photograph was taken in the dry season; a much greater volume of water leaps down the cliffs in the high-water season.

River. From the north it is joined by the sparkling Yosemite River, which John Muir says is one of the most songful streams in the world. In speaking of the Yosemite Valley, this celebrated nature lover once wrote: "It contains the noblest forests, the loftiest granite domes, the deepest ice-sculptured canyons, the brightest crystalline pavements, and snowy mountains soaring into the sky twelve and thirteen thousand feet. Gardens of wild blossoms are on their sunny brows. Cataracts roar gray and foaming in the crooked, rugged gorges. At their feet are new-born lakes, free, or encumbered with drifting icebergs like miniature Arctic Oceans, shining, sparkling, calm as stars."

One of the lovely blue and green waters of the Yosemite





Yosemite, Valley of Marvells.. Scene in the lower part, showing Bridal Veil Falls and, at the left, the cliffs of El Capitan.

is Mirror Lake. The Indians tell a story of a thirsty squaw who drank this lake dry one day, selfishly forgetting the needs of her husband. He beat her with his stick, which made her so angry that she threw her basket at his head. Because of their quarreling, the Great Spirit turned them both into stone, and they are still to be seen as the two peaks, North Dome and South Dome — or Half Dome, as the latter is usually called.

El Capitan is one of the highest of the bounding walls of the Yosemite. Close by it is a triple mountain, called the Three Brothers, because upon it three sons of a chief of the Yosemite tribe were killed in a battle with the whites.

Until 1851 no white man knew anything about this valley of marvels. Then some soldiers who were chasing Indians discovered it and sent out stories concerning the place that were as hard to believe as John Coulter's account of the Yellowstone. The Yosemite is so wonderful that, until one sees it for himself, the truth concerning it seems like a wild exaggeration. There are few places in the world where nature has clothed herself more sublimely than in the Yosemite, few places where smooth rocks, worn by vanished glaciers, show more plainly than here.

The word *Yosemite* means Big Grizzly Bear. The Indians gave the valley this title in honor of a young chief who, during a famine, killed a monster grizzly and gave his people a great feast. The name of this chief was Tenaya, but after his feat of bravery his people called him Yosemite, which in time came to be the name alike of the tribe and of the valley.

Other glacier-molded valleys occur along the west flank of the Sierras. Particularly to be noted are those carrying the American, Tuolumne, San Joaquin, and Kaweah rivers, all beautiful, though lacking the special majesty of the Yosemite.

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## KINGS RIVER CANYON

About a hundred miles south of the Yosemite Valley there is another marvel of nature that was deepened and remodeled by glaciers long ago. This is the noble canyon of the Kings River, named, we read, for the Three Kings of Bible history. It has higher walls than the Yosemite, but they are not nearly so steep. Between them foams the clear Kings River, and all around are mountains with glittering, snowy crests.

On the north slope of Mount Brewer above East Lake is Ouzel Basin, a huge depression cut out by the ice. Here John Muir studied the water ouzel in its home, and wrote of it one of the most delightful accounts yet given of any bird. He called it the "humming bird of the California waterfalls." Here, too, one may watch the winter wren, the marmot, the tiny mountain cony, and the still smaller chipmunk.

From high up on the imposing divide that separates the waters of the Kings River from those of the Kern, one can see dozens of lofty mountains in glorious waves of distance. The peaks that shut in Kings Canyon tower very high, more than half a dozen of them reaching a height of twelve thousand feet and over — a good two miles. Some of them — Mount Brewer, Mount Rixford, Mount Gould, University of California Peak, and Stanford Peak — are as high and quite as majestic looking as the Alps of Switzerland. In fact, these mountains of California so rival the famous peaks of Europe that some years ago Dr. Jordan named them the Alps of the Kings-Kern Divide, an appropriate title, if we assume the Swiss Alps to be a sort of measure of mountain grandeur.

Comparing the Sierras with the Swiss Alps, we see that the Alps have greater variety of form and greater contrasts of green and white, with the eternal snows overtopping leafy

forests and flower-carpeted meadows. The Sierras are richer in color, with a dry, stimulating, balsamic air. The summer sky is an unbroken blue, and a superb view rewards every climber. The huge glacial basins, now bare, are scarcely less impressive than if they were filled with ice, as in Switzerland. The Sierra forests are much finer than the second growths now left in the Alps. They offer the largest trees on earth — pines, firs, spruces, and cedars, while above them all towers the giant sequoia.

#### GLACIER NATIONAL PARK

Far up against the Canadian boundary line in the north-western corner of Montana is Glacier National Park. This is a land of lakes, rivers, and towering mountains, which bear on their sides more than sixty glaciers, alternating with impressive cliffs, broadly streaked with red, yellow, and slaty blue, according to the nature of the strata composing them.

We find also in this highly picturesque region a striking geological formation, called the Lewis Overthrust. This is a belt, eight miles long, of very ancient rock which, in the wrinkling and folding of the mountain district, was pushed up and then shoved over and across deposits of much more recent age. Such overthrusts, large or small, occur here and there in many much-broken ranges.

In the great ice ages the moving glaciers began cutting and sawing this mountain region and piled up moraines that became the banks of lake beds. There are two hundred and fifty known lakes in Glacier Park, and very likely, hidden among the unexplored gorges, we might find many more. Nineteen valleys slope down from the Lewis Overthrust, seven on the east and twelve on the west, and each one has its river fed by a glacier that is still at work far up among the peaks. Some of these valleys are so wild that only the





The Three Sisters, one of the most picturesque mountain groups in the Canadian Rockies.

Blackfeet Indians, whose reservation adjoins Glacier Park, have visited them. Indeed, this region with its eternal snow is one of the most grandly beautiful spots in America.

#### THE CANADIAN ROCKIES

The finest scenery of the Rocky Mountains traversed by a railway lies along the Canadian Pacific. Banff is a popular resort in the foothills to the east. Field, higher up at the base of Mount Sir Stephen, overlooks the vast, bare, impressive Yoho Valley, with rushing waterfalls at the head of the great Saskatchewan River. At Lake Louise one has a noble view of mountain, snow, and lake. The Selkirk range lies to the westward and in its heart is the station of Glacier, so named for an enormous ice-fall at its very door. Some



miles south of Glacier in the spruce woods on the west flank of the Selkirks is the majestic Asulkan Glacier, comparable to the noblest in the Alps, a great moving mass surrounded by rocks covered with heather and gentians, dropping down to the head of the Kootenai River.

#### THE PRAIRIE COUNTRY

Even on the level lands between the Appalachian Mountains and the greater ranges of the Northwest, we find traces of the work of glaciers. There are broad, sweeping prairies that once were shallow lake beds formed in depressions in the surface over which the glacier passed. These lake beds in time became swamps, which gradually filled and dried up. The prairies are rich in stories, not only because of the strange things nature did there during the distant past, but because upon them both men and animals have had many strange experiences.

If you have read many Indian tales, you know that the Red Men loved the prairies, those vast, unbroken spaces over which they could ride with no peaks or cliffs to hinder their progress, and no trees except along the banks of streams. They followed the herds of buffaloes and antelopes that ranged these majestic plains, and obtained their food by hunting. The Indians have nearly all gone from the prairie region now, and some of the wild creatures they pursued have gone entirely, while others have almost disappeared. But before the Red Men went, many a sorrowful chapter was enacted on the great plains, for as the whites moved westward, crowding on the natives, the tribes bitterly resented what they regarded as the stealing of their lands. Therefore throughout the prairie region massacres and Indian wars occurred.

Along the great prairie rivers, the Platte and the Missouri, Colonel William Frederick Cody, known as Buffalo Bill, spent years as a government scout and Indian fighter. Through



Chief Three Bears and a group of present-day Blackfoot Indians on their reservation near Glacier National Park, Montana.

this same region Kit Carson, famous guide and trapper, hunted and fought his way from Nebraska to New Mexico and California; and across them moved the wagons of the pioneers who developed the Rocky Mountain region and the Pacific coast. Besides those who became famous, there were many others as worthy. "Hidden heroes of the Rockies," Isaac Russell has styled these men who are unknown to history, but who are as deserving of our remembrance as the most celebrated of all the pathfinders and pioneers.

Ages and ages ago, glaciers spread over the prairie region lying north of the Ohio and Missouri rivers and extending far up into Canada. After the ice melted, this vast area was dotted with bodies of water. Gradually some of these disappeared, as the swamp grass filled up the depressions,

until by and by the dead grass mixed with the crushed glacial rock scattered over them and formed a thick black soil.

On the prairies trees do not easily grow, and almost the only wooded places in this region are on the tops of hills and along the sides of streams. And in the prairie country there is not a great variety of trees — a scattering of silver maples, box elders, and cottonwood. Even when the prairies are broken, trees do not readily take to the soil. About the only ones that can be well cultivated are the native kinds like the silver maple, which is the ordinary shade tree in many prairie towns.

The prairies are particularly well adapted to the cultivation of grains. Indian corn flourishes everywhere, and wheat grows even on the northern plains of Canada, as far as the Peace River and the Mackenzie. The prairies are also exceedingly rich in spring flowers. To view an unbroken prairie is an event in the life of any botanist, or of anyone who loves beautiful growing things, for so many lovely summer-blooming flowers and so rich a variety can hardly be found anywhere else, save in the pastures of the high mountains.

## CHAPTER FIVE

### A STORY OF LAKES

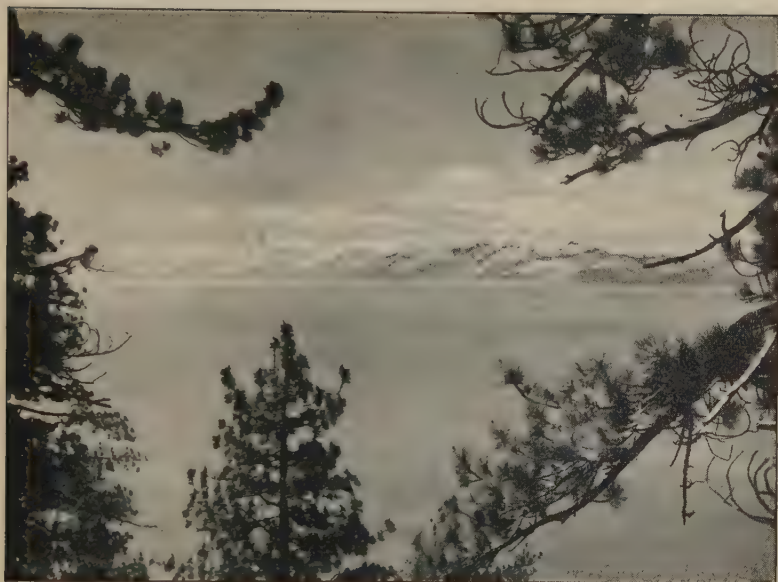
#### I. LAKE PONTCHARTRAIN AND LAKE BORGNE

ALTHOUGH many lakes were made by glaciers, by the ice scooping out beds or piling up walls of moraine, you must not think that all lakes came about in this way, because nature has a great many ways of doing things.

When a river flows through a sandy country, it carries down a great deal of sand; and when the river comes to the sea, this sand is thrown back again until a sand bar or dam is formed about the mouth of the river. When the fresh water gathers behind this dam, it sometimes turns the mouth of the river into a lake. Near New Orleans, in the state of Louisiana, are two such lakes made by sediment damming up a river where it enters the gulf, Lake Pontchartrain and Lake Borgne. A curious thing about Lake Pontchartrain is that in it are found fishes and creatures of both fresh and salt water. The senior author has seen in this lake big alligators along with little sharks from the sea and channel fish from the river, all equally greedy in disputing for garbage thrown off the wharf.

If you look at a map of the Gulf coast, you will see in Louisiana and Texas a number of lakes that have been formed by the throwing back of sand. In swamps at the head of these lakes one finds the cypress. It grows standing in the water, and the base of the trunk becomes greatly thickened below the water level, forming a small terrace just above the surface. Frogs are sometimes seen sitting on this terrace, and turtles lie flat on it. Often water snakes glide around the cypress and swallow frogs that sit there, and then away along the surface of the water they go, making the letter S in endless succession.





Lake Tahoe, the "Big Water" of the Washoe Indians, showing a portion of the rim of mountains that surrounds the lake.

## II. LAKE TAHOE

When man wants to form a lake, he builds a dam of rock and earth across a stream. But nature can do it by putting a dam of lava across a river. In this way has been formed one of the most beautiful large lakes in the world, Tahoe, in the high Sierras. Tahoe is an Indian name which means Big Water.

Lake Tahoe lies across the boundary line that divides California from Nevada. Its bed was made partly by glacial excavation and partly by an earthquake rift, or fault line, which runs across the Truckee River. Lava flowing out from this rift dammed the river gorge and turned it into a lake.

Far back in the wigwam days, the Washoe Indians told a curious story concerning the origin of Lake Tahoe, and they

tell it yet when they come up from the Nevada valleys to fish in the clear waters during the summertime.

In the long ago, say the Red Men, there was no lake in this part of the mountains. A prosperous and happy people dwelt on the very spot where the waters of Tahoe ripple today, a tribe so mighty that it possessed the whole earth. After many years a stronger people rose up and enslaved them. These mightier ones oppressed the weaker in every way and treated them so cruelly that it angered the Great Spirit. He rolled a wave in from the sea that engulfed both slaves and oppressors and drowned so many that only a few were left after the flood.

But that made not a particle of difference in the way the remaining oppressors behaved. They treated their unfortunate brethren more cruelly than ever. They forced them to build a tower that should be a refuge if another flood came. The slaves were kept at work day and night and were not allowed even to eat or sleep, but were lashed with whips to make them toil faster, until some dropped dead beside the loads they carried.

Then a strange thing happened. The earth shook, and the land began tossing like the sea, sending out fire, smoke, and ashes. The oppressors took refuge in the partly finished tower but would not allow the other people to come near it. Flames tore across the earth and leaped to heaven. Stars melted and ran down deep into the ground, where they hardened into the gold that white men seek. The Sierras rose, towering so high that their summits pierced the clouds; but where the tower had stood, the land sank and water flowed in to fill it. It became a lake, the one we know as Tahoe. The oppressors in the tower climbed to its top and clung there with a mighty effort to save themselves, but the Great Spirit would not let them go on as masters of the land in which they had been so wicked. He walked on the water and threw them one by one into a cavern at the east end of

the lake. The Indians say they are there yet and there they must remain until it pleases the Great Spirit to set them free. To this day the Washoe tribesmen call the east end of Lake Tahoe Spirit Lodge, and say that each spring, when the melting snow swells the waters and drives the wicked ones farther back into their prison, they can be heard wailing and moaning and begging to be released.

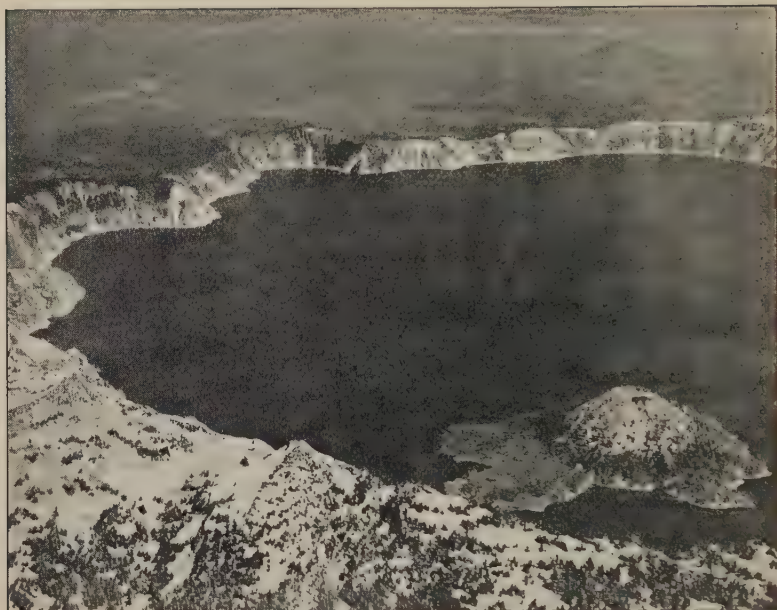
And the people who had been enslaved, were they destroyed too? Not so, say the Washoe Indians. They fled to the Humboldt River as the earth began to rise and fall, for the Great Spirit showed them the way. There they found canoes, in which they escaped from the fiery uplands, and lived in the low country until danger was passed, when they went back to the mountains. They became the ancestors of the Red Men of the Sierras, who to this day squat around their camp fires in the crisp, still nights and tell strange stories of the long ago.

### III. CRATER LAKE

Nature has also more violent ways of making lakes, some of which occur in the tops of old volcanoes, others in sunken valleys made by earthquakes.

You know a volcano is a mountain which sends steam, sulphur vapor, lava, and usually ashes out through a basin called a crater. Sometimes when mountains with wide craters on top have grown cool, nature fills these craters with water and makes lakes. In this way Crater Lake in southern Oregon came into existence. With its high vertical walls and deep blue water, it is the most picturesque of all basins of its kind in the world. There was once a volcanic cone here whose top extended high above the surrounding land. Then during some great disturbance the cone sank far within the earth, leaving only a broad crater, which afterward filled with water.

The Indians believed Crater Lake was the home of a god



Airplane view of Crater Lake, showing Wizard Island, a cinder cone within the old crater.

whom they called Llao. They said that the crayfish swimming in the clear waters of this lake were his servants and helpers. In the Klamath marshes near by, a great chieftain named Skell made his home. His servants and helpers were the eagles and the antelopes of the plains. Very often there was warfare between Llao and Skell, because each of them wanted to be ruler of that region.

One day the chieftain Skell was captured. The crayfish of Llao threw him into the water with such force that his feet stuck in the sand at the bottom of the lake. He is sticking there yet. His head is still to be seen above the shining current, and white men call him Wizard Island.

The tribes of this region believed also that the waters of Crater Lake were magical and that whoever bathed in them would be wonderfully strengthened and restored to youth.



#### IV. THE LAKES OF SOUTHERN MISSOURI AND TENNESSEE

Another way in which nature can make a lake is by sinking land during an earthquake. If you will look at a map of Missouri, you will see in the southeast corner of that state a projection running south which takes a notch out of the state of Arkansas. If the map is a good one, it will show a series of parallel lakes, long, narrow bodies of water like the Finger Lakes of New York. These lakes were formerly low lands crossed by rivers flowing into the Mississippi. In 1811 this region was shaken by an earthquake. In several places the land sank, going down twenty or thirty feet, and never rose again. These sunken places filled with water and became long, shallow lakes.

At the same time lakes were formed just across the Mississippi River in the state of Tennessee. The largest of these is Reelfoot Lake, which is one of the most famous retreats of wild geese, ducks, and other migratory birds in America.

Reelfoot Lake is about fourteen miles long and five miles wide in the broadest portion. Parts of it are very deep; it is said that many attempts have failed to determine how far down its waters extend. It covers what was once the war-dance ground of the Chickasaw Indians, and its transformation into a lake aroused so much fear in the Red Men that they would not venture near it. These fears and imaginings gave rise to many stories of supernatural creatures who were supposed to haunt the shores and waters of the lake. Consequently the negroes of the old plantation days believed it was peopled with ghosts and goblins and dreaded it as much as the Indians.

#### V. OTHER LAKES MADE BY EARTHQUAKE AND VOLCANO

In southern California is Lake Elsinore, made by an earthquake a century or more ago. It has no outlet and its waters are slowly becoming salty, but not to such a degree as to in-



Reelfoot Lake, Tennessee, as seen from an airplane. In this shallow portion of the lake moss, lily pads, and trees are growing in the water.

convenience the toothsome catfish which men have placed there.

Snag Lake is a body of water, not very large, which owes its origin to a volcano close by. Geologists know that this lake is not very old because there are trees standing in it which are dead but not yet rotted away. It lies in California on the east side of Lassen Peak, a volcanic peak that has not yet given up its efforts to throw out ashes and steam. Some seventy years ago this mountain sent out a mass of hot material which fell across the bed of a stream and dammed up its channel, turning it into a lake; and all the trees in the vicinity, having their roots submerged, were drowned. Lassen has twice in recent years (1920 and 1924) had a series of eruptions, of much less extent but enough to show that it is still alive and hot within.

Around the foot of the mountain is a group of little geysers made by water percolating down until it comes in contact

with the red-hot lava, and there the steam it forms forces it out again. One group of these sputtering springs is known as Bumpus' Hell, because Mr. Bumpus was the first to uncover its iniquities. Not far from there is a small lake of what would seem to be vinegar, for its waters are saturated with sulphurous acid, which makes them exceedingly sour, and poisonous if one takes enough of them; but no one is tempted to take more than a single taste.

## VI. THE LAKES OF MEXICO

Scattered throughout central and western Mexico are many lakes, the largest of which is Chapala, near Guadalajara, famous for its fish. These beautiful bodies of water lie in upland regions, and seem to have been made by the sinking of river basins during earthquakes, of which this country has had a great many.

In the high valley in which the City of Mexico lies there were formerly three large lakes, but because they kept the climate damp and chilly they were drained about twenty years ago by cutting a tunnel through the mountains to the east and drawing off the water. By this draining process the climate of the City of Mexico was made far more healthful and pleasant.

## VII. AMERICA'S VANISHED SEAS

### LAKE BONNEVILLE AND GREAT SALT LAKE

Ages ago in the western part of our country there were several great lakes or seas which have long since disappeared. The largest of these lakes covered what is now the great basin of Utah, and the portion that remains is known as Great Salt Lake. The ancient body of water has been given the name of Lake Bonneville. It was many times larger than the present one, and when you go to Utah, you

will see its old shores hundreds of feet above the lake that lies there now, forming a level rim along the mountain sides all around it.

Lake Bonneville flowed out on the north to what is now Snake River, and in time it wore a gorge through the deposits which formed its banks. It was fed by the waters of its three main rivers — the Bear River, the Provo River, and the Jordan; but the evaporation from the surface of the lake in summer was greater than the supply of water brought in by the rivers. The water of the lake gradually fell lower and lower; the overflow shrank away until by and by the lake had no outlet at all.

As streams move along, they carry down little portions of salt they pick up, for almost everywhere salt is scattered through the soil. When a lake ceases to overflow, the salt cannot get away, so it stays in the water year after year and century after century, until the water becomes saturated with it. What is now left of Lake Bonneville is a body of water saturated with salt, because, having no outlet, it cannot get rid of the salt brought into it by the rivers. For this reason it has come to be called Great Salt Lake. In this lake there is no living thing except the larvæ of a small salt-fly and a little brine shrimp.

When drifting sand blows into a salt lake, it stays there for the same reason the salt stays, because there is no out-flowing stream to carry it away. Sometimes in this way it happens that sand fills an entire lake. In the desert regions of the world this has occurred more than once.

The same condition that makes the lake in Utah salt applies to the Dead Sea in Palestine, as well as to the Caspian Sea, the Sea of Aral in central Asia, and many other bodies of water in Asia and Africa. Sometimes the salt mingles with compounds of magnesia, or with soda or potash. When a salt lake dries, we find all these substances left in the bed.





The old shore lines of Lake Bonneville as they appear today, high above the present Great Salt Lake. Each one of the terraces represents a beach or cliff of long ago when the water stood at that particular level.

When the Mormons who built Salt Lake City came over the mountains, they saw that the Utah basin with its salt lake was much like Palestine with its Dead Sea. In Palestine, the River Jordan flows down from a clear lake called the Sea of Galilee or Lake Tiberias, and its waters are lost in a sea of salt. And in Utah, or Deseret, as the Mormons called that region, a stream abounding in fish came down from Utah Lake, a clear body of water like that of Galilee, and lost itself in the same way in Great Salt Lake. So the people named this stream the River Jordan, and imagined the valley as a new Zion hemmed in by stately mountains, even as is the valley in Palestine.

#### LAKE LAHONTAN AND LAKE IDAHO

Another large lake occupied the portion of the great basin to the west of Lake Bonneville, covering much of what is

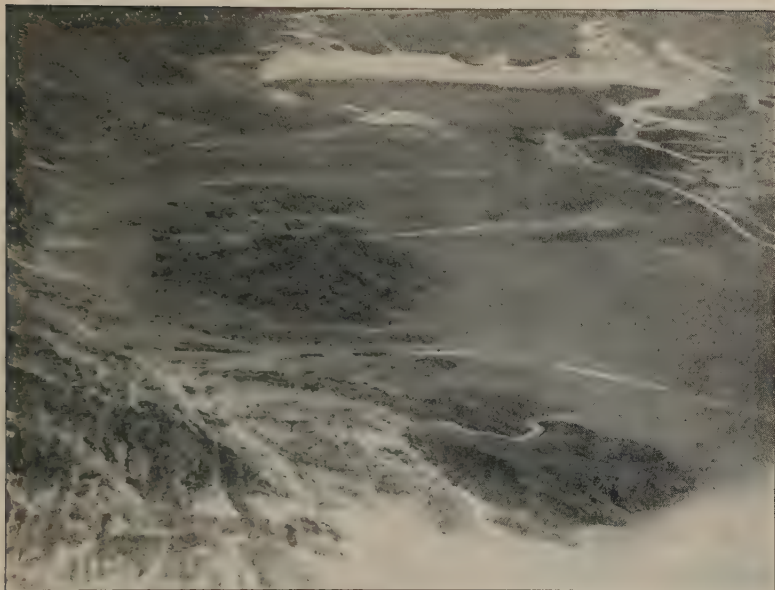
now the state of Nevada. This body of water vanished long ago, partly through evaporation, partly because of filling up with sand. It is known among geologists as Lake Lahontan.

Lake Lahontan was fed on the east by a river now called Humboldt, which has its source in "the Valley of a Thousand Springs." From the west, the Carson and the Truckee rivers brought their waters, but for a long time these streams wasted themselves on the plains, because the old lake which they fed had vanished. Now, however, the waters of these rivers have been put to good use for irrigation purposes. The Humboldt flows into Humboldt Lake, and the Truckee into Pyramid Lake. A large portion of the flow of Carson River is diverted for irrigation; the excess waters flow partly into Carson Lake and partly into Carson Sink.

A great inland sea once covered a large portion of southeastern Oregon and is known to geologists as Lake Idaho. This too has largely disappeared, drying up like Lake Bonneville and Lake Lahontan, leaving behind it a few disconsolate lakes and swamps, with deposits of salt, soda, and other minerals—useful refuges for migratory water birds.

#### DEATH VALLEY AND OWENS LAKE

In the eastern part of California, extending over towards the boundary of Nevada, lies Death Valley. This is a deep depression in the mountains lower than the sea. It is practically without water, and becomes fearfully hot in the summer. The name of Death Valley is very appropriate when one thinks of the many people who have suffered or lost their lives in attempting to cross it, pioneers bound for the Pacific coast and miners seeking gold. All the names in this valley are weird and fantastic, but extremely fitting because of the history of the place. The Funeral Mountains shut it in on the east, while to the west are the Bonehill Peaks, and between them one finds Jawbone Gulch, Skull Canyon, Lost



Airplane view of Death Valley. For total desolation there are few places that equal this region.

Wagons, and many another gully with a name that tells a tragic story.

Even though Death Valley has been a terrible region because of the suffering that men have endured there, it is not an ugly place. It is wondrously interesting, with a strange, weird beauty very unlike that of lands of green fields and running brooks. It is a country of gorgeous colorings, especially at dawn and sunset, when the Funeral Mountains and Bonehill Peaks are as rich in color as the robe of an emperor. Sometimes, in traveling across it, one beholds a mirage, in which appear lakes and flowing streams or a man on horseback looking like a giant out of one of the old hero tales of the North. Now and then there is a castled city or a fleet of ships, many-sailed and beautiful as the galleons of our dreams. A mirage is a false appearance due to the



Traveling through Death Valley in the old days.

presence of different layers or strata in the atmosphere. The surface of one of these layers reflects like a huge mirror, and from a distance appears like the surface of a clear lake.

Death Valley is an old sea bottom from which the water has long since disappeared. It became a salt lake like the one in the basin of Utah, and when it finally dried up, the soda, borax, salt, and other mineral substances in its waters were left in grayish white deposits on the sandy wastes. Fortunes have been made by men who have taken borax out of Death Valley. Its mineral wealth also is great, consisting of gold, silver, lead, copper, marble, and onyx. Hearing of those who had succeeded in getting some of the treasure hidden in this weird, sun-smitten land, many men have gone there in the hope of finding wealth and, overcome by the distressing heat and drought, left their bones on the sands.

A short distance west of Death Valley, near the base of Mount Whitney, is Owens Lake. Like the inland sea of



Utah, this has no outlet, and the water is salty. Slowly but surely, Owens Lake is drying up, like the others. It is becoming smaller and smaller, and some day there will be a depression there like the one we call Death Valley, with deposits of salt, soda, borax, and other substances that have been left behind by the vanishing waters.

#### SALTON SEA IN THE IMPERIAL VALLEY

One of the most noted of America's vanishing seas is Salton Sea in the Imperial Valley. It was once a part of the Gulf of California, but was cut off from it long ago by the sand and clay deposits of the Colorado River. Out of these deposits the Colorado River built up a little bank of its own in the shallow upper part of the gulf. This new shore in time shut away some forty miles of water to the northwest of the place where this river flows into the gulf, making a salty lake below sea level, known to geologists as the Salton Sink or Salton Sea.

Very little rain falls in that part of the country, and with the exception of the Colorado River, there are no streams of any size. So in time this upper part of the gulf became entirely dry, although portions of it are two hundred feet below the level of the sea. This made a bare desert with scanty cactus, ocotilla, greasewood, and other thorny plants. In the deepest part, where the water of the gulf had remained the longest, deposits of salt were left. But excepting for its lack of water, the soil of the basin was mostly good. A few people settled there, and through the aid of water from wells managed to farm small bits of ground.

It occurred to a settler in the neighborhood that if water from the Colorado River could be turned into this desert valley, tropical trees and plants could be made to grow in abundance, for the summer climate is intensely hot. Some of the local people dug out a small channel for the river,



Salton Sea, California, at its highest stage in 1906.

which it accepted with enthusiasm, cutting a gorge more than a hundred feet deep and deluging a large part of the valley. A lake formed in the basin of the old Salton Sea. Part of the Southern Pacific Railroad between Indio and Yuma was submerged and had to be moved higher up on the side of the valley. For a time it looked as if the entire region would change into a lake, and the homes of all who had settled there would be destroyed.

But the skill of engineers prevented that. The river was forced back into its old channel and held where the people wanted it to stay. The harnessing of this great stream required a vast amount of labor and the expenditure of enormous sums of money by the United States government and the Southern Pacific Railroad, and is regarded as one of the great feats of modern engineering. By a system of canals, with gates to regulate the flow of the water, the desert valley was made to bloom by means of irrigation. Now thousands of people live in Imperial Valley in both California and Mexico. Enormous crops of alfalfa are raised there to feed great herds of cattle. Cotton is produced in

abundance, and cantaloupes are grown by thousands of car-loads. People also raise on their irrigated lands dates, avocados or alligator pears, and other delightful fruits of the tropics.

## VIII. AMERICA'S GREAT SWAMPS

### THE DISMAL SWAMP

In the southeastern part of Virginia and in the neighboring portions of North Carolina there is a great swamp filled with cypress trees. These trees grow in shallow water, and around them are frogs and snakes and water birds and all that goes with the gloom of cypress swamps. In the central part of this swamp is a lake three miles long and two miles wide. It is known on the map as Lake Drummond, but nearly everybody speaks of it as the Lake of the Dismal Swamp. A good many stories, some of which are true, have been told of its mysterious depths.

The water of a cypress swamp is stained a dark coffee color. In fact, all northern streams flowing through ever-green bogs have this black water, but it is wholesome because nothing poisonous comes out of the bark of cypress, spruce, or fir. So the water of the Dismal Swamp, almost black as it appears, is acceptable to fishes, and it has often happened that naval men at Hampton Roads send over to the Dismal Swamp for their supply of drinking water. It was valued by old-time seamen also because it would "keep," having no microbes in it. The real danger of all swamps is to be found in the mosquito, which may carry microbes of malaria from one person to another. Because of the many mosquitoes breeding in them, some swamps are dangerous in summer.

The Dismal Swamp was formerly much larger than now. It used to cover about twenty-two hundred square miles, but in recent times so much of it has been drained and



Lake Drummond in the heart of the Dismal Swamp, Virginia. Notice the cypress trees.

reclaimed for lumbering and farming that it is now scarcely two thirds of its original size.

The story of the reclamation of the Dismal Swamp is of special interest because the idea originated with George Washington, who was by profession an engineer. Just after the close of the Revolutionary War, he organized a company for the purpose of draining a portion of this great waste. A canal, the remains of which are to be seen to this day, was cut from the town of Suffolk to Lake Drummond, and still bears the name of the Washington Ditch. But in those times the science of engineering was not ready to cope with so great a problem as the draining of the Dismal Swamp, and with the failure of the Washington Ditch to carry off the water, the project had to be abandoned. But long afterward the idea that originated with our first President was worked out successfully, and today hundreds of acres of what were once waste lands are being utilized.

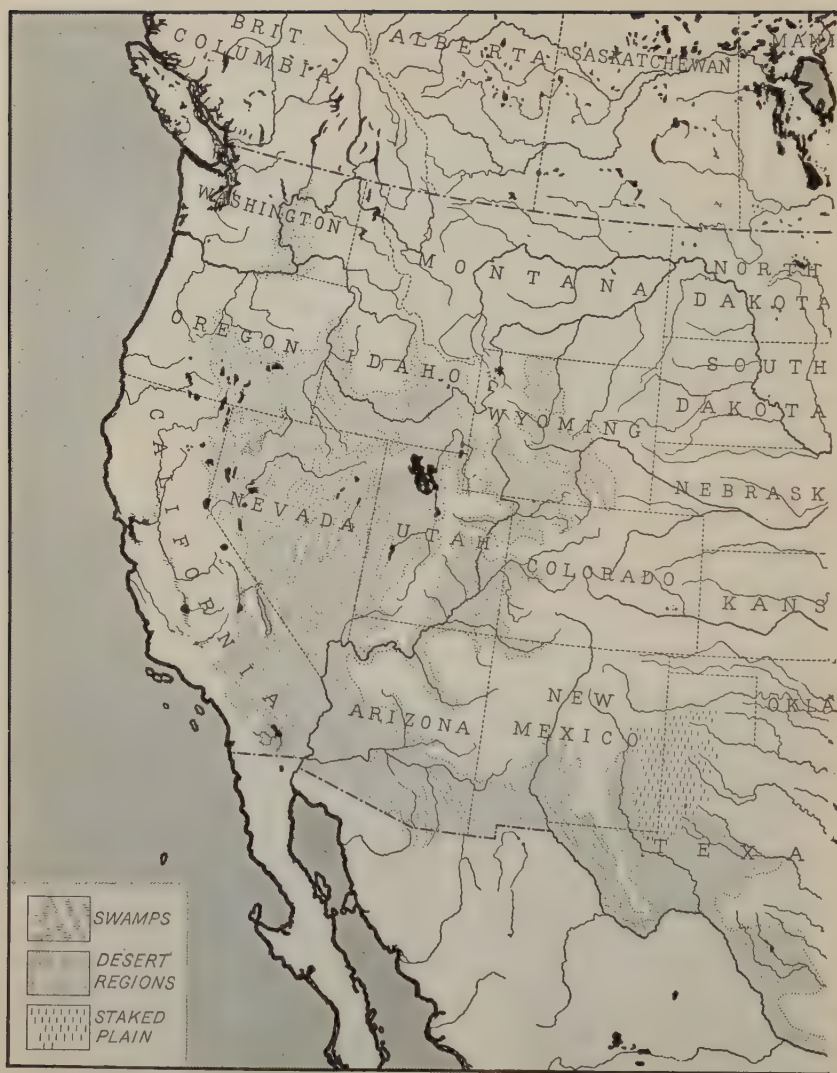
There are a great many fish in the Lake of the Dismal Swamp, especially catfish and suckers. And there also is found a tiny fishlet called the fish of the Dismal Swamp.



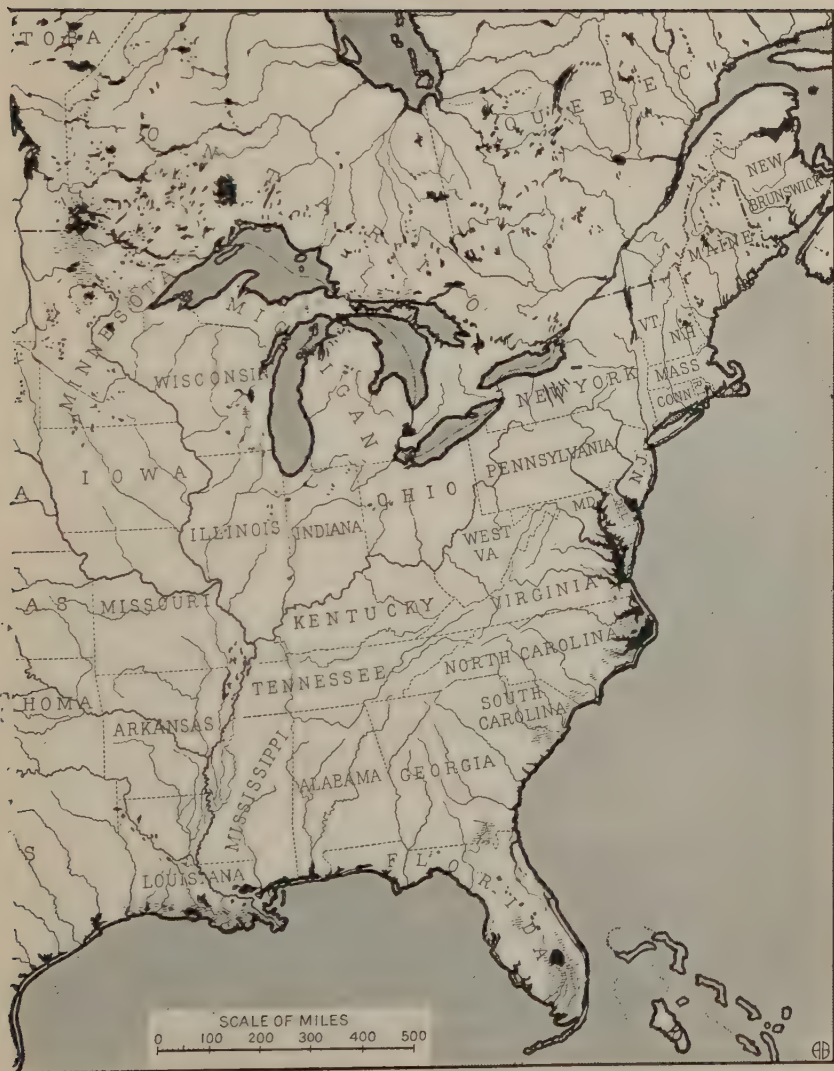
This is interesting because it is left over from an earlier geological period. Nothing like it is to be found anywhere else in the world, outside the lowland swamps and ditches and the streams in caves of the limestone region of the lower Ohio River country, into which some fishes went thousands of years ago and did not come out again. The descendants of these creatures, living in darkness, had no use for eyes, and in time lost them, becoming what scientists know as cave blind fish. They lost also the black stripes they had had along their sides, for what is the use of having stripes if nobody can see them? At least, that seems to be a part of the plan of nature, for whenever a fish, a bird, or any animal possesses something for which it has no use, it is likely to lose it. Those with useless organs work at a disadvantage, and in the strain of existence they tend to disappear.



Swamp lands after being drained and cleared of trees. The drainage ditches keep the land fairly dry so that it may be cultivated.



Map of the United States showing the river  
Note the relation of the river systems



systems, swamp areas, and desert regions.  
to the swamps and the deserts.

Although at last, according to the law of nature, fishes and other creatures lose the things they do not need, they are provided with whatever is necessary to hold their own in the conditions under which they live. The blind fish had to feel their way, so their skin became covered with little papillæ, like those on a cat's tongue, and so sensitive that they respond to the least commotion in the water. To creatures living in darkness, such sensitive touch organs are worth more than eyes.

#### OKEFENOKEE SWAMP AND THE EVERGLADES

The states of Georgia and North Carolina have a heavy rainfall, which feeds many underground streams flowing down into Florida. These streams rise to the surface and cover large tracts of land, forming many lakes and several great swamps.

The most northern of these swamps, called the Okefenokee, lies partly in Georgia and partly in Florida. It is a vast wilderness of pine forest, cypress, and black-gum and is the home of alligators and of many varieties of wild birds. It contains also many interesting varieties of swamp plants and flowers. This swamp is said to be free from malaria, which afflicts neighboring regions. It is well stocked with little fish which devour the eggs and young of disease-bearing mosquitoes.

Down in the southern tip of Florida lie the Everglades, an almost inaccessible swamp, haunted by alligators and by the rare American crocodile, and well stocked with many kinds of fish. In the northern part of the Everglades is a round lake called Okeechobee, which has much in common with the Lake of the Dismal Swamp. These swamps of Florida, with their cypresses overspread with flowing vines of yellow jessamine and with long gray moss hanging from every branch, are singularly picturesque.

Because for almost a hundred years after the founding of our country nobody was able to explore the Everglades, they



came to be regarded as places of mystery, and all sorts of weird and impossible tales were told about them. In 1835 the Seminole Indians, after warring for many months against the white men, retreated into the Everglades — the trails of which were well known to them but were wholly unknown to the palefaces — and there they held their ground successfully. With their fear of the Indians added to their fear of an unexplored swamp country, people dreaded these dark and gloomy places and stayed away from them.

The first white man to go far into the Everglades was a Spaniard who was shipwrecked in the straits of Florida and made captive by the Seminoles about 1840. For seventeen years he was a slave among the Indians, but finally he escaped and gave authentic information about this region. After that, the United States government sent a number of expeditions into the Everglades, but because of the dangerous morasses and the fierceness of the Seminoles, one group of explorers after another was unsuccessful. In 1892, however, Lieutenant Willoughby led a government expedition through the wilds and, notwithstanding Indians and alligators, came back with a clear account of the place.

The alligator is strictly an American product and is found in coastwise swamps from Florida to Texas. These creatures look like huge lizards and are very ferocious with their long jaws and big teeth, and they sometimes give hard blows by lashing their tails. There is not much difference between the alligator and the crocodile. The alligator has a broad snout, and its teeth show less when the mouth is closed than is the case with the crocodile, which has a narrow, pointed face. Both alligators and crocodiles have heavy jaws. It is better not to trifle with either of them, especially if the beasts are anywhere near grown. There are very few crocodiles in the United States; most of these monsters live in Africa. But the alligator never goes out of our country unless somebody deliberately carries one off.

In the Everglades and all through the southern states is a little fish two and a half inches long which swims near the surface of the water and is called top-minnow or *Gambusia*. In Cuba, when an angler goes out and catches nothing, he is said to be fishing for gambusinos, which is the Spanish form of the word. This fish is worth knowing, however, because it feeds on the larvæ of mosquitoes, darting after them with unflinching accuracy and catching hundreds a day.

In 1904 the people of the Hawaiian Islands asked Dr. Jordan to help them get rid of mosquitoes, so he sent one of his students, Alvin Seale, to gather top-minnows. Mr. Seale went to Galveston, Texas, filled milk cans with the little creatures, and carried them to Hawaii, where he turned them loose. Being hungry, the *Gambusias* went after the mosquitoes and ate them up by thousands. Since then the descendants of these fishes have been carried to the Philippines and to Formosa, and because they increase more rapidly than the mosquitoes, they clear out the mosquitoes speedily wherever they are placed. But they are sensitive to cold and cannot be reared in frosty regions. They are now so plentiful in Hawaii that their crushed bodies serve as food for the fishes in the aquarium of Waikiki in Honolulu.

## CHAPTER SIX

### AMERICAN WATERWAYS: A STORY OF RIVERS

#### I. THE ORIGIN OF RIVERS

RIVERS are like gypsy wagons. They come out of the unknown and glide away into the unknown, and a real live boy or girl is just as eager to follow the course of a stream as he is to trudge after the gayly painted vans that carry wandering children of the road. The idea of going to the source of a river, or to the place where it empties into some other body of water, seems like a great adventure.

Rivers begin in various ways. Some are made by the overflow from lakes. The streams flowing into the lake basin fill it so full that it overflows and forms another river. These are grown-up streams even at their sources. But most rivers were once little brooks formed by the overflow of springs, fed by heavy rains or melting snow, and growing larger as they received the waters from other little streams. If you watch the ground after a heavy rain, you can see just how this happens, how the water trickles down into low places, and gathering in a tiny stream moves along until other streams enter it, and what was very small in the beginning becomes larger and stronger.

Springs have their beginning in underground streams or in soakage of water through porous layers of earth or rock. After a rainfall some of the water runs off on the surface of the ground, but much of it seeps down through the soil. Sand and gravel soils are porous; they absorb water very much as a sponge absorbs it. If these porous soils are deep, the water goes down through them until it comes to a layer of rock or heavy clay through which it cannot pass. It then moves along on the hard surface underground until it reaches some opening from which it emerges as a spring.

## II. THE HUDSON AND MOHAWK RIVERS

The Hudson River rises in the mountains of northern New York. The Indians believed it had its beginning in a spring of eternal youth, and men who have gone to its fountainhead think it not at all strange that they cherished such an idea. Far up in the Adirondacks it has its source, beyond Mount Marcy, which is known among Red Men as Cloud Splitter. Some miles north of this peak is Indian Pass, one of the very few places in the eastern part of our country where the ice lasts all summer long. Here is a crystal mountain lake appropriately called Tear-of-the-Clouds, and out of this filters a ribbon of water which becomes larger as it journeys southward because other tiny streams pour their flood into it. Thus the Hudson grows into the broad river that flows through a gentle valley between the hills, and beneath its famous Palisades moves majestically to the sea. It is not a long river and not much water flows in it, but the tides from the ocean run far up this stream, making it one of our great waterways.

In all America it is hard to find more charming scenery than that along the Hudson. Here are bold cliffs, hills of many shapes and heights, and valleys with fertile farm lands and hospitable country houses.

Just above the Palisades are the picturesque Catskills, called Sky Land by the Indians. These are rounded hills of very hard rock covered with pine and fir, abounding in springs, and affording a delightful breathing place for multitudes from the crowded city of New York. Here, according to an old legend, lived Rip Van Winkle, a likable but most trying ne'er-do-well, who, to escape the nagging of his wife, trudged to the uplands one day for a bit of peace among the pines. He had a most peaceful time. He took a nap that lasted twenty years and woke to find his companions dead, himself an old man, and his country a republic.





Airplane view of the Hudson River at West Point, showing some of the buildings of the United States Military Academy.

In the Catskills too, legend says, Henry Hudson and his men still play at ninepins, for you must know that this Englishman in the service of Holland was the discoverer of the river. When his good vessel was safely moored in some inlet, the captain and his crew used to troop away to the hills for relaxation. The thunder in the Catskills is supposed to be the thudding of their ninepins as the balls strike them down. Washington Irving very charmingly retold both of these legends in his story of Rip Van Winkle, which is one of the classical tales of American literature.

Because the Hudson was discovered by a man sailing in the service of Holland, its shores were claimed by that country and settled by her people, and names of towns and cliffs all along this stream can be traced back to words from the Dutch language that was once spoken there.

Yonkers, a city near the mouth of the Hudson, was originally Jonkheer's Land, Young Gentleman's Land, and was called after a group of rich young Hollanders who first owned it. Anthony's Nose, one of the craggy points along the Hudson, was named for Anthony Corlaer, a rollicking, reckless Dutchman of whom many stories were told. There was a saying among both Dutch and Indians that no human being could swim the river at a point just above the head of the island of Manhattan, for there it makes a whirlpool. But Anthony declared he would do that very thing "en spuyten duyvil" — in spite of the devil. He plunged in and was never seen again; and to this day the little stream that is the northern boundary of Manhattan Island is called Spuyten Duyvil Creek.

The first steamboat that was permanently successful made her maiden voyage on the Hudson. This was the *Clermont*, built by Robert Fulton in 1807. Almost nobody but the young inventor believed a ship could be run by steam. As the vessel set out from New York for Albany and moved steadily along, snorting noisily and sending out clouds of smoke from the soft coal burned in her engine, there was much amazement. One farmer from the back-hill country, who had not heard of the proposed trip but happened to see the boat on its way, remarked, "The devil is going to Albany in a sawmill."

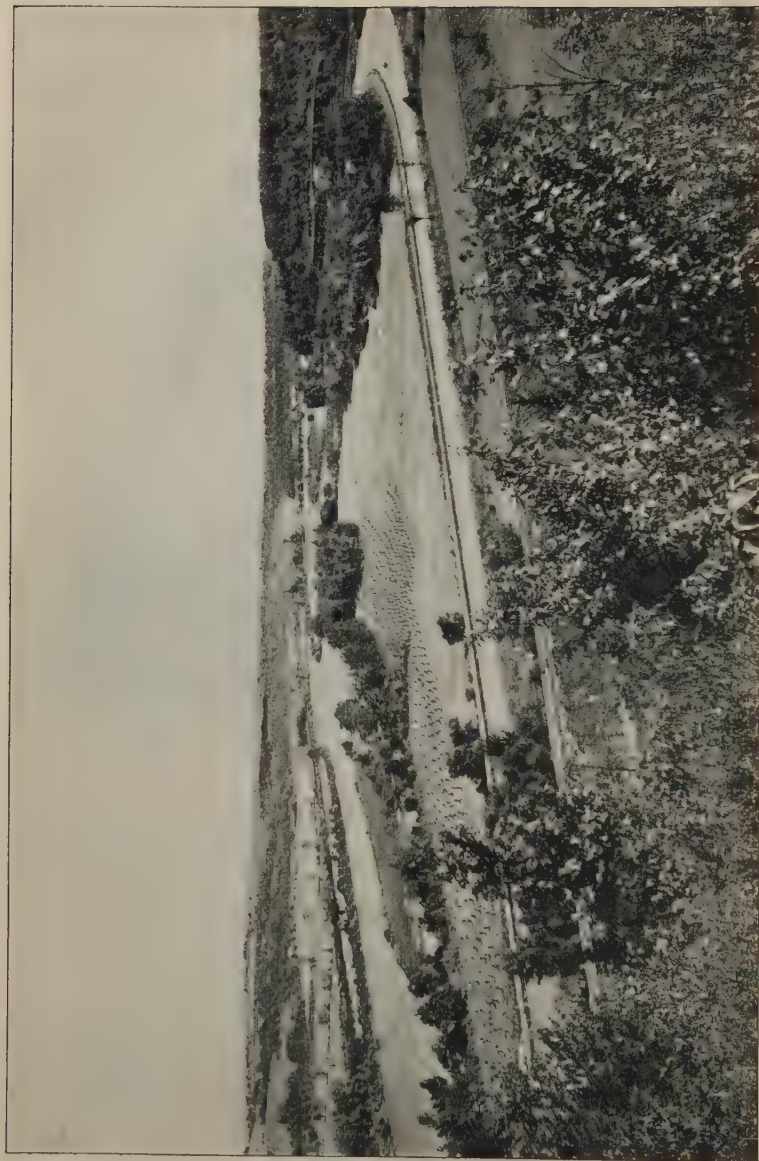
The day of the *Clermont's* first trip was a great one in American history, for it marked the beginning of a new era in the story of navigation. After the invention of the steamboat the New World and the Old World became only a few days apart, instead of weeks, as was the case when vessels crossed the seas entirely at the mercy of winds.

! On Manhattan Island, at the mouth of the Hudson, stands New York City, the metropolis of the western hemisphere, and the second largest city in the world. When Henry Hudson sailed up the river, about three hundred years ago,



Replica of Fulton's *Clermont*, the first steamship, alongside of the *Leviathan*, the latest and largest today, photographed on the Hudson River at New York City.

London, Paris, and Vienna were thriving capitals, and nobody dreamed that a day would come when on the forested island where the Hudson enters the sea there would be a city that would compete with any of them. But that very thing happened. Manhattan Island was purchased from the Indians for twenty-four dollars, and on it a settlement of white men grew. It has been growing steadily and rapidly ever since. Now, over three million people live upon the island alone, and the city has spread to the shores beyond Manhattan until New York City has a population of over six million people, and is the largest city in the world.



The Mohawk Valley, once the route of the great Iroquois Indian trail, and today the route of three important means of travel — the railroad, the canal, and the highway.



New York City has some wonderful buildings; they are called skyscrapers because they are so high, and it seems as if they must have been raised by a magician out of the *Arabian Nights*. Some of them are thirty or forty stories high, and one towers up more than fifty stories.

These skyscrapers have been made possible by the skill of American architects and engineers, who were confronted with the problem of building toward the sky because, as the population and business of New York City increased, there was not enough space on the ground to hold the structures that were needed. Therefore the only thing that could be done, if the city was to provide for its growing population and industries, was to erect high into the air. The hard rock of which Manhattan Island is composed helps to make this possible.

Coming from the west and emptying into the Hudson near Troy is the clear Mohawk, a stream that flows through a charming valley and carries almost as much water as the Hudson itself. It takes its name from the Indians who once lived along its banks, the proud Mohawks, strongest of the fierce tribes of the Iroquois. These, with the Onondagas, the Cayugas, the Oneidas, and the Senecas, were one mighty nation until disputes over territory split them into five divisions. But their interests were so nearly akin that, after a time, they were reunited into the league of the Iroquois, the most powerful of all Indian confederations. The form of government of this confederation provided for a council of fifty sachems, and their chief meeting place was in the Mohawk Valley.

North and west of the Iroquois lived the Algonquins, whose chief tribes were the Illinois, Wisconsin, Chippewas, Ottawas, and Wyandottes. The Wyandottes were called Hurons by the explorers from France because the arrangement of their hair suggested the bristling head of the wild boar, the French word for which is *hure*. The Algonquins



and the Iroquois were constantly fighting each other, and the Mohawk Valley was their battleground.

This valley is the natural highway from the Atlantic seaboard to the Great Lakes; again and again it has played an important part in the development of our country. When settlement by the white people began in what is now New York State, the first road to the west was through the Mohawk Valley, following the trail of the Indians. Many years later, when the transportation problem came to be a serious one, the people built the Erie Canal near the line of this same trail, connecting Lake Erie and the Hudson. And about two generations after the passing of the Indians, a railway was built, linking the Atlantic coast and the Great Lakes country, and this too used the trail the Iroquois chiefs had followed to battle or to council fire.

The same thing has happened in other places besides the Mohawk Valley, for the Red Men were the best of pathfinders and always discovered the shortest and most desirable way of getting from one place to another. The great Indian trail from Virginia and Maryland into Kentucky and Ohio was widened into the Wilderness Road or National Pike. Up in the northwest country was the Oregon trail, the footpath of many northern tribes. Over it went the men who broke through to the Pacific under the leadership of Lewis and Clark. Now the Northern Pacific Railroad follows very nearly the line of this Indian trail. A study of how the ancient tribal footpaths became the great highways of our country shows how the efforts of one generation contribute to the comfort and prosperity of the next.

### III. THE RIVERS OF NEW ENGLAND

Most of the rivers of Maine are formed by the overflow from lakes. The Kennebec has its beginning in the bright waters of Moosehead, while the overflow of several lakes

swells the Penobscot, a swift, clear stream that sweeps through spicy forests to hurl its flood into Penobscot Bay.

Today there are thriving towns along the Penobscot, but a hundred and fifty years ago its shores were dotted with the wigwams of the Indians from whom this waterway takes its name. Their chief village was situated where the town of Bangor now stands, and their tribal hunting grounds extended for miles in every direction. The Penobscots were friendly to the white men and supported the cause of the colonists during the Revolutionary War. They have almost died out now, less than a hundred being left of what was once a powerful tribe, but still on the territory held by their forefathers they keep to the ancient tribal customs.

Most of the rivers of Maine are fed by black-water streams which are stained to the color of coffee by the evergreen swamps along their course. These rivers used to abound in trout, but sawdust has changed all that. Nearly all the streams of Maine flow through a wilderness of pine and spruce, and wherever a river goes through an evergreen forest, sawmills are likely to spring up along its banks. As one of Maine's great industries is lumbering, there are many sawmills there, and a great deal of sawdust from these mills goes into the streams. Sawdust plays havoc with the spawning ground of fishes, and consequently the salmon and brook trout that used to run in these rivers have largely disappeared.

From the point of view of the fishes, these rivers have suffered too from the crude oil that escapes from refineries on their banks, and from the waste of paper mills, which are much worse for any fish than sawdust is.

Dams are no more friendly to fishes than sawdust, oil, and the waste from paper mills, and in some rivers of Maine the dams have practically closed the streams. As the salmon run in these streams, they either die in their efforts to get

on, or cast their eggs where they will not hatch, and by and by these beautiful water folk are seen no more.

In some streams the salmon have been partly saved by means of fish ladders. These are inclined planes constructed with cross pieces on the sides, which check the flow of the water. When the fish come to one of these ladders, they make their way in and out between the cross pieces, up and over the dam to the level water beyond.

Several years ago the governments of both the United States and Canada appealed to Dr. Jordan and his colleagues to try to solve the problem of maintaining the fish in the mill and refinery region along the Maine-New Brunswick line; but they were unable to find any means of doing it except by getting rid of the sawmills, the obstructing dams, and the refineries.

Down from the White Mountains flow the Saco and the Merrimac. The latter is the principal river of New Hampshire. Along the banks of the Merrimac were the old hunting grounds of the Pennacooks, who lived in a village which they called Amoskeag, meaning the Great Fishing Place (near the present Manchester). Here, when the shad were running freely, the braves speared stores of fish and dried them for the winter. In the shelving rocks that make the rapids of Amoskeag are many curious cavities, or potholes, some fifteen feet deep and eight feet in diameter. Geologists say such potholes were excavated by stones that were swirled about in eddies by the force of the current, wearing the depression deeper and deeper as time went on. But the Indians believed the Great Spirit cut the holes there as a storing place for provisions, and during their frequent wars with the Mohawks, the Pennacooks found these cavities convenient hiding places for their food.

From up near the Canadian border comes the Connecticut, which makes the boundary between New Hampshire and Vermont. Farther along in its course, it spreads out wide

as it runs quietly to the sea, and on its banks is a beautiful variety of stone known as brownstone. Great quantities of this brownstone have been quarried, and many of the finest of the old-time mansions in New York City were built from it.

This stone was once dark, iron-stained sand that was carried down by the stream and thrown back by the tides, which ran high there. Upon these sands ancient reptiles left their tracks. When the water ebbed, the sand hardened in the sun, and the next tide brought in more sand that filled the footprints. Later the sea fell away; its deposits, long before this time, had been cemented into the stone that we find there now. The tracks the reptiles left upon it are still to be seen. People at first took these to be bird tracks, but scientists know that there were no birds in that long-ago period.

The many swift streams flowing down from the mountains of New England have had a good deal to do with the development of that part of our country. They have long been used as a source of water power for manufacturing. They empty into the bays that break the shores of Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine, where there are many good harbors. The streams, flowing largely over ledges of hard rock, carry very little sand to the sea. So the bays are not made shallow and spoiled by deposits of sand and clay, as is likely to be the case where streams flow through regions of soft rock and carry a great deal of material to the ocean.

On the shore of Massachusetts Bay, Boston grew from a small colonial settlement to a great city. This wonderful development has been due, in part, to the manufacturing which sprang up because the people found in the swift streams of New England a vast source of water power. Because of Boston's fine harbor, it was possible to send out on ships to other lands the articles that were manufactured, and to bring back materials needed for manufacturing and trade.



IV. THE DELAWARE AND THE RIVERS OF  
CHESAPEAKE BAY

Flowing out of the hills of southeastern New York is the Delaware River, a swift stream with many tributaries. It breaks through the mountains at Delaware Water Gap, then moves on to the south, forming the boundary between Pennsylvania and New Jersey, and emptying into the arm of the Atlantic known as Delaware Bay. At its mouth the sea comes in to deepen its waters so that the river is navigable for big ships; and in this fact we find the reason for the growth of the city of Philadelphia upon its banks, for you must know that cities never spring up by accident. Always they stand where they do because a stream, lake, or ocean affords shipping facilities, because a fertile back country needs a market center for its produce, because a waterfall or swift stream furnishes power for manufacturing, or for some other definite reason.

Philadelphia is one of America's oldest and most beautiful cities, founded in 1682 by the Quakers under William Penn. It was known as the City of Brotherly Love. Penn's treatment of the Indians made them the friends of the white people, and there was no struggle between the two races in this colony. It was in Philadelphia that the Declaration of Independence was adopted, and this city was the first capital of our country. Now the old Quaker settlement has become a thriving modern city, a manufacturing center of great factories and business blocks. But amid the modern structures many of the historic old buildings still stand. Most famous of these and dearest to the hearts of Americans is Independence Hall, where the Continental Congress declared independence from Great Britain, and where the Liberty Bell proclaimed the freedom of the colonies.

Delaware Water Gap is a gorge about fourteen hundred feet deep, where the Delaware River makes its way through

the Kittatinny Ridge. Some geologists have thought that a lake once existed behind this gorge, and the Indians must have had some such tradition also, for they gave to the gap the name Minisink, meaning the place from which the water is gone.

Among the hills of Delaware Water Gap lived Chief Tammany, who sold to William Penn the land upon which the colony of Pennsylvania was founded. Tammany and Penn became warm friends, because the Indian trusted the stranger who would not steal his lands but paid him well for them, and the Quaker respected the tribal leader. In the tongue of the Delawares, the name Tammany means affable, or kindly and gracious, and tradition describes this chief as being worthy of the title. He was a lover of peace and a warm friend of the white men. In fact, the pale-faces regarded him so highly that some of them, who held picnics and May Day festivals on the hillside where he lived, called themselves Sons of St. Tammany. After the close of the War of the Revolution another organization took his name and became known as the Tammany Society. This society underwent many changes and in time became a strong political power. It has its headquarters at Tammany Hall in New York City, an important center of the Democratic party.

Chief Tammany lived to be old and feeble. He met his death in a fire that destroyed his home, and his people buried him where he had loved to be during his lifetime, on the hill called Mount Tammany that looks down on the calm beauty of Delaware Water Gap.

The great river of central Pennsylvania, the Susquehanna, comes down from Otsego Lake in central New York and, winding through the glacial valleys, gathers up its tributary streams and passes, clear and shallow, across Pennsylvania and Maryland into Chesapeake Bay. Baltimore, the sixth city in size in the United States, stands on the west bank

of Chesapeake Bay not far from where the Susquehanna enters it, the fine harbor making possible a commerce that has developed a tiny settlement of colonial times into a metropolis.

Into Chesapeake Bay too comes the Potomac, a stately river, although not very much water runs in it. Like the Hudson, the Potomac is rich in historic lore. It comes from West Virginia and western Maryland, and having no glacial valley to direct its course, flows eastward and southeast till the salt waters of Chesapeake Bay come in and give a little river the appearance of a great one.

On the northern bank of the Potomac stands the city of Washington, the most beautiful of all American cities. In Washington, people from all over the land gather to make the nation's laws. There are magnificent private homes and government buildings, many beautiful parks, and wide streets lined with spreading trees. Above all rises the superb dome of the Capitol, the building in which Congress holds its sessions.

The Potomac has several tributaries. Largest of these is the Shenandoah, a winding stream that mingles its flood with that of the Potomac at Harpers Ferry, a place noted in the history of the Civil War.

South of where the Potomac enters the Chesapeake, the James River flows into that bay, coming down from the Blue Ridge Mountains of Virginia, and enough like the Potomac to be its own brother.

Chesapeake Bay receives also the waters of the Rappahannock, smaller than the James but like it in several ways. Its waters are red, because it runs through the red clay soil of Virginia. On its way to the ocean it is joined by its chief tributary, the Rapidan.

The tide comes up in all these streams, in fact, in every river that flows to the ocean along our eastern coast from the Hudson down to Florida. For this reason, the Atlantic



Airplane view of the Potomac River near Washington.

shore is often called the tidewater country. People speak of tidewater Virginia, tidewater Maryland or Delaware, meaning the parts of those states where the ocean waters come up into the river mouths.

The rivers that flow into Chesapeake Bay have a peculiarity that is not shared by all streams. They are what geologists know as drowned rivers, which means that the places where they enter the sea are not their real mouths. Instead of ending where they disappear, their channels extend for a considerable distance under the ocean, and thus are drowned or covered by the sea. This is because much of what is now Chesapeake Bay was once land, and these rivers flowed across that land to the ocean far east of where we see their mouths today. The streams wore away the ground as they carved out valleys, and the land in this region gradually sank until it was below the level of the sea;



thus the water came up over the land and the bay was formed.

If the bed of Chesapeake Bay were to be suddenly lifted so as to become dry land again, we should find that the Susquehanna is the main stream of this system and that the Potomac and the James flow into it somewhere east of Norfolk. But the bay has covered the real mouths of these streams, making them seem independent rivers instead of one great system.

The Hudson is another drowned river, and so are most of the streams of Maine. Besides these, there are several such rivers in California, about which you will hear something later.

The soil built up by the rivers of Virginia has made rich farming land, and very early in the history of our country colonists along the Rappahannock and the James began growing produce for their tables and crops to ship to the Old World as a source of income. Chief among these was tobacco, a plant whose leaves Columbus found the Indians winding into little cylinders and smoking.

When the great discoverer and his men returned to Spain, they carried with them stories of how the natives of the new land "ate fire and blew smoke out through their nostrils." They took some tobacco back too, and smoking became fashionable among the Spanish noblemen. From Spain the custom spread to France.

The English who settled Virginia found that the Indians there also "ate fire and blew smoke out through their nostrils." Sir Walter Raleigh took some of the weed with him to the mother country, where smoking soon became the fashion. Consequently a great demand for tobacco arose, and the Virginia colonists, finding that the plant grew luxuriantly in the fertile river bottoms, went into the business of raising it. Every man who had a garden or a field grew as much as he could on his land. Along the Rappahannock



Map of a portion of the North Carolina coast, showing how the ocean waves have built up, from the material washed down by the rivers, a series of long, narrow islands and capes far outside the main shore. The area shown here is a part of the Atlantic coastal plain, low, level, partly swampy land that was once below the sea.

and James rivers market centers were established where ships bound for the Old World took on the crops of the planters, and these market centers rapidly developed into towns. Chief among them were Richmond and Norfolk. As the tobacco culture increased, and as cotton and peanut growing were added to the industries of that region, they developed into thriving cities, among the largest in the South.



Airplane view of a wave-built sand spit enclosing a long, narrow lagoon. Before the new beach was built up by the wash of the waves, the inner edge of the lagoon was the shore line.

## V. THE RIVERS OF THE SOUTH

As we go southward, more rivers appear, rising among the Blue Ridge Mountains. They flow down through the red soil of North Carolina, and then through sandy pine woods to the sea, through soil they themselves in earlier years have brought down. At the mouths of these rivers, part of the sand they carried is cast back again by the ocean and piled up so as to form long bars and sand spits. These bars and sand spits shut off portions of the sea, forming partially inclosed bodies of shallow water that are known as sounds. In such cases, it is plain that once upon a time the bars of land that shut the sound off from the sea were not there, but they were carried down by rivers as grains of sand and piled up by the waves which beat the sand back toward the shores.

Some of these sounds are large and some small. On the coast of North Carolina is Albemarle Sound, fifty-five miles



Airplane view of a portion of Pensacola Bay, Florida, showing how the currents and waves have blocked the old outlet, forcing the stream to seek a new outlet farther down the shore.

long, and a little farther to the south is Pamlico Sound, which is twenty miles longer than Albemarle. All the way down to the Gulf of Mexico, sounds have formed along the sandy shores. If you look on a large map, you can count almost a dozen.

One peculiarity of the rivers of the South, or rather of the people who live along their banks, is that whenever two great branches flow together the stream takes a new name. Thus the Staunton and the Dan form the Roanoke, which helps to make Albemarle Sound; the Saluda and the Broad unite to form the Congaree. Others lose their names when they cross state lines, like the Yadkin, which becomes the Great Pedee when it enters South Carolina.

The western part of Georgia is drained by a mountain stream, the Chattahoochee, whose praises have been sung by Sidney Lanier in "The Song of the Chattahoochee." This river rises in the mountains in the northern part of the



state, turns toward the southwest, and meets the Flint River. The stream formed by their union, called Apalachicola, swings down through the sandy plains and marshes of western Florida to the Gulf of Mexico. The rivers of Florida — among them the St. Marys, St. Johns, and Suwanee (made famous by a song) — rise in swamps and sandy plains and wind through the low country to the sea.

In one respect, some of the streams of the South are like those of Maine that flow through evergreen forests; their waters are stained by the dark liquid soaked out from peat bogs and from the fallen foliage of trees, for in the Carolinas, Georgia, and Florida are stretches of country covered with a dense growth of pines. Along the coast of these states grows a species of pine, from the sap of which turpentine is made, a substance used in the manufacture of varnish, soap, and various other things.

Most of the rivers of Mississippi and Louisiana make their way through swamps to the Mississippi River. On both sides of these rivers, as well as along the Mississippi itself, are bodies of water which go by the name of bayous. Once each of these bayous was part of the river at a place where it made a broad bend. Across this bend the river would cut its way in flood time, and along the mouth of the old channel it would make a sand or mud bar, damming in the water behind the bar and leaving a moon-shaped pond back in the country. There are more than forty bayous on the Mississippi, the Yazoo, and other streams of Mississippi and Louisiana.

Scattered among the pines of the southern states grow the palmetto trees, sometimes standing so close together that they form an impassable jungle. Because of the myriads of palmettos within its borders, South Carolina chose this tree as the emblem on its state seal, and therefore is known as the Palmetto State. But there are quite as many of these trees in Louisiana along the courses of the



A bayou in the lower Mississippi Valley.

rivers as in South Carolina. In fact, palmettos are thoroughly at home throughout the coast-bordering states of the South.

The rivers of Texas are like those of North Carolina, coming down from the hills and in their upper courses clear and swift; some of them are fed by large springs. But as they flow down into the low country and pass across sandy plains and woodland tracts on their way to the gulf, they gather up a great deal of soil, and in their lower courses are sluggish, often turbid streams.

The largest rivers of Texas are the Sabine, the Trinity, the Brazos, the Rio Grande, and the Colorado (not the great river of the same name, which means red). The Rio Grande forms the boundary between Texas and Mexico, and is the greatest of all these Texas streams. It is a very long river, rising high in the mountains of Colorado, and in



Along the upper course of the Missouri River in Montana.

its upper course is turbulent and swift. But as it passes through the arid lowland region, its waters are drawn off for irrigation. It receives few tributaries and becomes almost dry in summer. Very little more water flows in the Rio Grande near its mouth than it had in Colorado near its source.

## VI. THE GREAT MISSISSIPPI SYSTEM

The greatest of all rivers in the world, the one in which the most water flows, is the Amazon, which rises in the Andes of South America. But the longest river, if we measure it to the source of its chief tributary, is the Mississippi, which sweeps through the great plains of the Middle West. This main tributary, the Missouri River, is fed by rivers flowing from the Rocky Mountains of western Montana, streams that come down from the pine forests filled with grayling and trout. Wonderfully clear streams are these, the Madison, the Jefferson, the Gallatin, and, farther down, the Milk

River, the Yellowstone, and others. But as the Missouri flows across North and South Dakota and on to the south, it passes through great beds of light soil and grows red and muddy. It loads itself with the material it tears away, so that by the time it is ready to enter the Mississippi, opposite Alton, Illinois, it deserves its name, Missouri, an Indian word which means Muddy Water.

At times in summer, when the current is smooth, the mud and clay in the Missouri gather in a mass so thick that it cannot fall to the bottom. It forms a layer a foot or two thick below the surface and a few feet above the real bed of the stream. Out of this soft mud, the river sometimes builds new banks and changes its course. This gives the water a new direction. When this occurs and the force of the current is swerved toward one of the banks, it sometimes happens, during flood time, that the river tears away the bank against which it is flowing. Occasionally a mile or two of the bank is carried away. The senior author has watched the work of the river at St. Joseph, Missouri. The last time he was there, in one section of the city the street nearest the river was Fourth, for the Missouri had cut in and a part of First Street, Second Street, and Third Street had gone down with the current. Fourth Street, we are told, is still safe from the river, and some ground in this section has been reclaimed.

The Mississippi has its source in the northern part of the state of Minnesota; and on account of bogs, swamps, and forests, it was not easy to find where the river begins. For a long time people tried to reach the source of the Mississippi, but without success. A group of explorers, passing lake after lake, finally reached a small one far up among the swamps and bogs, and concluded that it was the source they were seeking. They wanted a good Indian name to give to the lake but could not think of any. So they took two Latin words, *veritas*, which means truth, and *caput*, head,



to signify "true source." Running the two words together, *veritascaput*, they cut off the ends and called the lake "Itasca." And Lake Itasca it remains to this day. A truly melodious Indian name!

About a hundred and fifty miles south of where the Missouri enters it, the Mississippi receives the Ohio, a broad, swift stream which flows through a gently rolling country. The Ohio is formed in the mountains of Pennsylvania by the junction of the Allegheny and Monongahela rivers. At the point where these two streams meet stands the city of Pittsburgh, which has grown rapidly because of the necessity of a shipping center for the river commerce. Then, with the discovery of iron and coal in that region, it developed into a manufacturing center as well, one of the biggest and busiest in the United States.

Nearly three hundred miles southwest of Pittsburgh is Cincinnati, another important city built up by the river commerce and by the coal and iron of Pennsylvania, West Virginia, and Ohio.

Below the place where the Ohio joins it, the Mississippi River spreads wider and wider as it takes its winding course to the Gulf of Mexico. Its waters enter the gulf not in one big stream but in several branches, which form what is known as the delta of the Mississippi.

Deltas are triangular stretches of low land at a river mouth, built up from sand and other material brought down by the stream. They are called deltas because they have the shape of the Greek letter *delta*,  $\Delta$ . We speak of the delta of the Amazon and the delta of the Nile River, which spreads far and wide as it approaches the sea.

Deltas are formed only in level places, where a river has plenty of room to spread out at its mouth, where it carries a great deal of sand, and where the ocean tides do not run high enough to wash this deposit far away. On rocky coasts rivers do not often form deltas, because there the water is



Airplane view of a small portion of the Mississippi delta. The outer edge of the delta is made up of hundreds of similar stretches of land, which are constantly changing in size and shape.

fairly clear, the tides run high, and the material that a stream brings down is scanty and is washed out to sea. But on the borders of plains the river beds are not much above the level of the sea. These rivers run slowly and drop much of the material they are carrying before they reach the deep water.

This is true of the Mississippi. After the Ohio enters it, the stream grows wider and flows through land that is swampy and often flooded in the winter. It carries so much sediment, which drops to the bottom whenever the current is slow, that the bed of the river is being steadily raised. In some places the river bottom is on a level with the towns that lie along its banks.

Men try to keep the river from spreading over the ad-



The Mississippi River at Hickman, Kentucky. This airplane photograph, taken from a great height, shows how the river is constantly changing its course. Just around each bend, on the side of the river where the water flows more slowly, materials are being deposited. In the photograph these materials show through the shallow waters as light or shaded areas. Opposite these areas, where the water runs more swiftly, the banks are being cut away.

jacent land by building up high walls called levees. Then the crayfish gets to work, for its business is digging holes in soft damp ground. As fast as men pile up the walls, these little creatures try to undermine them, and their constant burrowing does a great deal of damage. It weakens the levees, and often when the river is very high the water breaks through, sometimes spreading far and wide over the land. After the breaking of a levee on Bayou Atchafalaya in Louisiana, the senior author has seen the water of the Mississippi up to the second story of houses that stood on the banks and the country was covered as far as he could see.

A break in a levee, like a crack or chasm in a glacier, is called a crevasse. Crevasses along the Mississippi are very much dreaded, because terrible loss of both property and life are likely to occur when the water comes rushing down. Men build the levees higher and higher and watch them very carefully, for they know that the crayfish are constantly at work digging holes in them.

On the banks of the Mississippi stand many busy, prosperous cities — St. Paul, Minneapolis, St. Louis, Memphis, Vicksburg, New Orleans, and many others: They owe their prosperity largely to the river. In its upper reaches it is a source of water power and through nearly its whole course it provides means of transportation for the various products that are to be sent away. All of these cities are busy industrial and commercial centers, especially Minneapolis, St. Louis, and New Orleans, which are among the richest, most populous, and most important cities in the United States.

Because the Mississippi River carries so much sediment, navigation through it into the Gulf of Mexico was formerly greatly hampered by sand bars at the mouth of the stream. To remedy this trouble, some years ago an engineer, Captain James B. Eads, built sea walls that are known as the Mississippi River jetties. Jetties are walls that extend from the mouth of a river out into a sea or gulf so as to narrow the flow of the stream and make it so deep and swift that it will tear away the sand bars. It is interesting to know how they are built.

From the mouth of the stream to the deep water beyond the sand bars, piles or tree trunks are driven into the bed of the gulf where the river current is to be narrowed. These piles are the foundation of the walls. It is very difficult to build walls in the gulf, and piles alone will not do it. Therefore branches of trees containing many twigs are tied together, and these are loaded with stones and gravel and



sunk to the bottom between the piles. Then more tree branches are fastened together, loaded, and sunk, until the space between the piles is filled. The river does the rest, completing the work man has begun. The sand and mud carried down by the river fill up the spaces between the stones, gravel, and branches, and before long there are strong, solid walls inclosing the current. The force of the stream, as it flows through this channel, tears away the sand bars and keeps other bars from forming there. Thus the ships can pass out to the gulf in safety.

Much of the commerce of the Mississippi would have been impossible without the Eads jetties. They have been worth millions of dollars to the people along this great stream.

## VII. THE RIVERS OF THE PACIFIC COAST

### RIVERS AND MISSIONS OF CALIFORNIA

There are drowned rivers in the western part of our country as well as in the East, and most of the larger streams of California belong to this class. One of these is the Salinas, which has its main source in the Santa Lucia mountains, and moves northward through the yellow soil of Monterey County, emptying finally into the Bay of Monterey. Its channel extends for some miles under the bay, because this bay covers what in ancient times was a valley.

The Bay of Monterey is widely famed for its beauty. Because of the loveliness of its outline, the blueness of its waters, and the towering hills that rise beyond it, it has often been compared with the Bay of Naples. It has an interesting history. Over three hundred years ago King Philip III of Spain commanded Vizcaino, one of the great navigators of that time, to cruise along the Pacific coast to see if a harbor could be found north of Mexico, because Spanish ships sailing to the Philippines wanted a harbor where they might take refuge during the long voyage.

Vizcaino set forth on his expedition, and one day he came upon a shining bay between pine-clad hills through which a river ran quietly down to the sea. Believing it to be the harbor he was seeking, he named it Monterey in honor of the Count of Monterey, Viceroy of Mexico, and sailed away with the good news that he had found a harbor large enough for all the navies of the world.

When the report of Vizcaino arrived, Philip III of Spain was too much worried over other matters to think about founding a settlement at the harbor. Nearly a hundred and seventy years went by, years during which sailors suffered greatly because the voyage to the far eastern islands was so long, and there seemed to be no place along the western coast of America where ships might stop for a while. Meanwhile, the Russians had worked southward from Alaska to Fort Ross in northern California, and Charles III of Castile, who was then king of Spain, began to fear lest he lose some of his holdings in the New World. He ordered that an expedition be sent to the Bay of Monterey to establish a settlement there, and under the leadership of Gaspar de Portolá and a good priest of the Franciscan order named Junípero Serra, it started out from Mexico and headed towards the north.

After many months of varied adventures, the expedition came to the shining waters Vizcaino had seen so long before. There was the same Point of Pines with a river to the south of it, the same ridge of hills piled behind it like a semicircular wall. But the Spaniards did not recognize it, or any of the landmarks noted by Vizcaino. He had sighted the place in December, when the knolls were green and the stream was swollen, but now it was October. The hills were dry and dead-looking, and the river had shrunk so much that it did not look at all like the one described in the report of the navigator; so they went away, seeking along the coast for the very bay they had just seen. They discovered the bay of San Francisco, "a Mediterranean Sea" with an outlet

they could not cross. There they turned back and sailed southward till they came again to the bay lying north of the Point of Pines. On June 3, 1770, they took possession of the land in the name of Spain, hanging bells on the venerable live oak under which Vizcaino and his Carmelite friars said mass in 1602.

Near by on the river they founded a mission, and there Junípero Serra and his assistants preached the Christian faith to the Indians. Beside the sea near the mission settlement rose the town of Monterey, which became the first capital of California.

The stream that gurgled down from the hills was called by the Spaniards El Rio del Cármelo, the River of Carmel, and it is still known as the Carmel. It flows into a little bay of its own, Carmel Bay, the fairest indentation on the whole California coast; and like the Salinas it is a drowned stream, for its channel extends far out to sea.

Wherever Portolá's expedition encamped, Father Crespi, the historian, gave Spanish names to hills and streams, bays and headlands. These names, melodious and colorful, give a romantic touch to California today.

Overlooking the fertile and beautiful valley of the Carmel River to this day stands the mission of San Carlos Borromeo in Cármelo, founded by Junípero Serra when he reached the Monterey coast in 1770. This was one of many missions established by the Spaniards in California; indeed the first one, the Mission of San Diego de Alcalá, was started near the bay of San Diego almost a year before the founding of Monterey.

Within the next fifty years missions for the Christianizing of the Indians were established up and down the coast. Every forty or fifty miles — a day's journey on horseback — they crowned some gleaming knoll or nestled in a sun-gilded valley, for the monks who established them had a keen eye for picturesque hills and rich pasturage. The bridle path



San Juan Capistrano, one of the most celebrated and most beautiful of the missions established by Junípero Serra and his followers along El Camino Real.

which led between them was called El Camino Real — the Royal Road; and in establishing the fine asphaltum and concrete roads which are now the pride of California, considerable effort has been made to carry them from mission to mission along the line of El Camino Real.

With the passing of years the missions of California fell into disuse and decay, because money for their maintenance no longer was forthcoming from Mexico and Spain. For a long time most of them were crumbling ruins, but recently some of the missions have been partially restored. The one at Santa Barbara — which, being built of stone, was able to withstand the ravages of time — has been fully restored. It was never abandoned, but has been continuously occupied since the day of its completion.

The adobe missions, built of sun-baked clay, did not fare so well as the one at Santa Barbara. For several generations most of these have been picturesque ruins, although some of the smaller ones, and portions of the larger ones, have been used as chapels. But through the efforts of the California



Landmarks Society, the work of restoring the missions is slowly going on, that they may stand as memorials of the days when the language of Spain was the language of California, and dark-robed padres traversed the coastwise valleys, spreading their religion among the Indians.

Along the entire length of El Camino Real, on the slopes and in the valleys, and to the very edge of the sea, grows the golden poppy, the most abundant flower of California outside the mountains. Near the sea it is small and bright yellow; inland, in good soil, it is deep orange. Luther Burbank, who can do as he pleases with California flowers, has developed one which is bright crimson in color.

The brilliant *copa de oro*, or cup of gold, as the Spanish-speaking settlers named it, is not like the poppies of the Old World, which have milky juice containing opium. But in southern California we find one of that kind, bearing a small flower of orange with a center of deep maroon. Then there is the tree poppy, which grows ten feet high and has bright yellow flowers. In southern California also grows the tall Matilija poppy with showy white flowers three inches or more across. The prickly poppy of the desert, thistle-like, with large white blossoms, is interesting to botanists, at least. The scarlet poppy, which flames in the green fields of Europe, has no representative in the United States and can be grown only with special care.

The rivers of San Francisco Bay have a history that goes far, far back. In the distant past, the valley of central California was one great body of water, with an outlet through a break in the mountains to the west. Then San Francisco Bay was elevated above the sea, and what had been a part of the ocean bed became the floor of the valley. Through this valley flowed the Sacramento River from the north and the San Joaquin from the south.

The Sacramento, joined by the waters of the San Joaquin a few miles east of San Francisco Bay, flowed on its way



San Francisco and the Bay, with Oakland and Berkeley in the distance.

century after century and near its mouth cut out a deep gorge. After a time this gorge became submerged, and the lower course of the river was covered by the sea. That is why the Sacramento, after emptying into San Francisco Bay, has a channel which extends under the water far beyond where the river itself disappears. The submerged gorge, formed in the long ago by the wear of the Sacramento, lies below the narrow entrance channel to San Francisco Bay, known the world over as the Golden Gate.

The history of San Francisco Bay is rich in romance. For a long time its fog-hidden entrance eluded discovery. To it, several years after the founding of the mission at Monterey, came on foot Spanish soldiers and priests from Mexico, again under the command of Gaspar de Portolá, and here, as at Monterey, they established a mission. Around the mission grew a settlement called Yerba Buena, which in

time developed into the great city of San Francisco. To-day, as the ships of the world go sailing in and out of the Golden Gate, and people watch them glide through the narrow entrance channel, probably very few realize that these ships are moving above a submerged gorge formed long ago by the waters of the Sacramento.

On the east side of the bay, among the wide-spreading trees that were abundant in that region, was established the town of Oakland, at first a residence suburb of San Francisco, but it has grown to be an important manufacturing and commercial center, one of the large cities of the United States. Also on the east side of the bay, adjoining Oakland, is Berkeley, a residence and university town, the seat of the University of California.

#### THE COLORADO AND THE COLUMBIA

The Colorado River receives the waters of two great streams — the Green River from Wyoming and a river from the mountains of Colorado long known as the Grand River; but in 1921 the name of the main stream, the Colorado, was extended to this branch. The Colorado is a swift stream of clear water until it gets well along to the south, where it becomes turbid; and there in Arizona it has carved out a gorge which is one of the most majestic in the whole world — the Grand Canyon. So much of the story of this great waterway is the story of the canyon, that we shall tell it to you later, with the tale of the curious things rivers sometimes do.

The greatest river of the far western part of the United States is the Columbia. Its source is in the Canadian Rockies of British Columbia. It flows northward and then makes an abrupt turn to the south as it circles around the splendid Selkirk Range. It picks up many little streams that come down from the mountains and forms two large lakes before entering the state of Washington. Close to the Canadian border the Columbia gathers in the waters of the



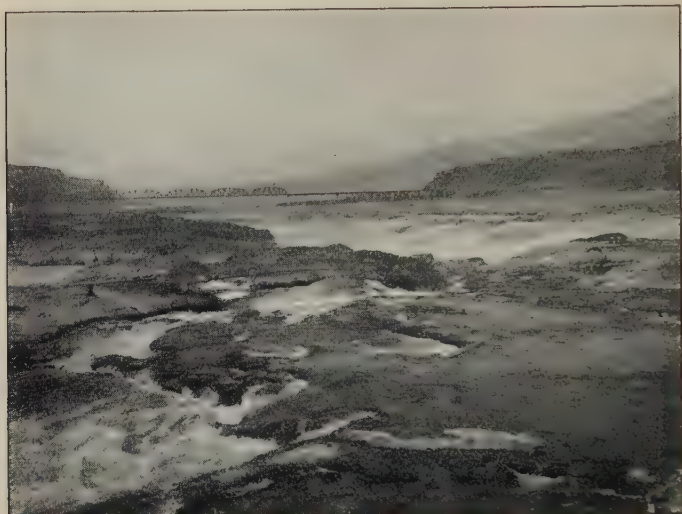
Airplane view of the Colorado River after it has passed through the Grand Canyon. Here it makes the boundary line between Nevada and Arizona.

Clark Fork. Much farther on it receives its greatest branch, the Snake River. After that it takes up several smaller tributaries which swarm with salmon in the summer-time, and passing with swift current over its rocky bed makes two great rapids, the Dalles and the Cascades. From there on, it moves with dignity to the ocean. The Columbia forms no delta, but it carries a great deal of sand, and the waves of the sea throw this sand back towards the land. Jetties have been built to hold back the sand and to keep clear the broad river channel east of it, which is so wide and deep that the great vessels of our navy can anchor there.

#### THE YUKON

Alaska's great river, the Yukon, is formed in northwestern Canada by the union of two streams which receive the overflow from many deep and ice-worn lakes, the most notable being Lake Bennett and Lake Laberge. It makes its way





The Dalles of the Columbia River, between Oregon and Washington.

through mountains into Alaska and flows majestically to Bering Sea. It is the greatest stream in America that empties into the Pacific Ocean, larger even than the Columbia.

On its way to the ocean, the Yukon gathers up numerous tributaries, the Stewart, the Klondike, the White, the Porcupine, and many others, some of which are mighty streams in themselves. Carrying a great deal of sand and other sediment, it forms a many-channeled delta almost a hundred miles wide. In fact, the Yukon receives so much material from its tributaries, and gathers such quantities itself, that it cannot carry it all. Like the Missouri, it drops some of it in places where the current slackens. This occurs especially about two hundred miles from its mouth, where the river makes a great bend to the southwest. The slackening of the current at this bend causes the river to deposit more material than it would if it swept along in a straighter course. Where it curves to the southwest, it forms a succession of sand bars and low islands, thickly wooded with spruce.

The scenery along the Yukon, where it sweeps through the mighty northern mountains, is very grand. Until about thirty years ago people knew little about this great stream. Then gold was discovered on the Klondike, a small tributary in the hills, and men rushed north by thousands in the hope of getting some of the precious metal. Scattered settlements were formed in what had been a frozen waste, and as throngs came and went, people all over the world heard of this hitherto undiscovered country. If you wish to know more of the glory of the Yukon River and the beautiful Alaskan country through which it flows, read the poems of Robert W. Service and the stories of Jack London.

About five years after the start of the gold rush, Dr. Jordan traveled through the upper Yukon country and his description of the trip in *The Days of a Man* is repeated here.

In connection with our work on the salmon fisheries, we crossed the mountains from Skagway to the upper Yukon at Caribou Crossing, the chief town of that region, now called Carcross. The railroad (then new) from Skagway northward goes over a magnificent mountain saddle known as the White Pass of the Yukon; along this famous trail the gold hunters of 1898 passed on their wild race to the Klondike. The beginning of this race I had myself witnessed. In June, 1897, bound for the Pribilof Islands, we stopped at Juneau, the metropolis of Alaska, and on that very day the Canadian surveyor, Ogilvie, since noted in history, arrived from across the mountains bringing a marvelous story of gold discoveries on the Yukon in the Canadian Northwest Territory.

According to Ogilvie, Skookum ("Swift") Jim, an Indian of Caribou Crossing, accompanied by three friends — Tagish Charley, Siwash George, and the latter's wife, who was Skookum Jim's sister — had wandered across the country looking for gold. One of the men became ill, and Siwash George's



Seward, Alaska, picturesquely located at the head of Resurrection Bay and almost surrounded by rugged, snow-capped mountains. The town is named for William H. Seward, who persuaded the United States government to purchase Alaska. It is an outlet for the gold mines in the vicinity.

squaw went to a brook to get him a basin of water. The bottom of the pan showed a streak of fine gold; subsequent dippings soon revealed more. Then Skookum Jim started out at top speed to record with Dominion officials the claims of himself and his associates. Bonanza Creek and Klondike were soon names to conjure with, while Dawson, the center of operations, became a veritable city almost over night.

Millionaire Jim afterward built for himself a fine home at Caribou Crossing and sent to Seattle to buy a Brussels carpet for the best room. When it came, however, it was found to be too broad by a yard. But these were heroic days, so Jim remedied the defect by having the house cut apart and the room spread to fit the covering!

When Ogilvie told his story in Juneau, the whole town broke loose, for it lies on the very frontier of adventure. Gamblers and gold seekers, clerks and lawyers, threw up their jobs and in one way or another got to the head of navigation at Skagway, and there struck the White Pass Trail. Then followed for two or more years one of the most astounding migrations in American history.

Southward from Juneau went out the word. Cigarette youths crowded the smoking rooms in Pullman cars bound north from San Francisco. Pampered St. Bernard, Great Dane, and mastiff dogs, many of them stolen, were dragged along to do the work of the half-wild Siberian "husky." Women came too, both young and old, of many types and varied nationalities. All were loaded with clothing and provisions designed for an Arctic winter; few had ever met hardship; none knew anything of "mushing" over blind trails through uncharted mountains, or the dodging of endless chains of impassable tarns.

Moreover, at Lake Bennett their troubles were far from ended, for of boats and the breaking up of the ice they were also ignorant. Many who risked the frozen surface a little too late in the spring lost their lives. Farther on, the perilous White Horse Rapids took large toll of those who preferred to chance it on boat or raft rather than to make the wearing portage of several miles overland down to Lake Laberge.

This route to Laberge follows along the boisterous Skagway River through fir woods and past glaciers, then climbs in long zigzags and windings by the side of reckless waterfalls and unbridged chasms to the open, moss-covered pass. In the gusty saddle lies the first of an uncounted series of lakes at the head of the Yukon. These are each very narrow, very deep, and sunk in a cleft with high rock walls — so hidden and so intricate in distribution, moreover, as to make it a serious problem to get around them.





Map of Alaska, showing the principal rivers, glaciers, volcanoes, and other features.

A sheltered depression on the summit should be historic, for there every band of Klondike pilgrims camped for the night. There also they cast away their luggage, traded off their horses, abandoned their dogs. Trodden into the mud of this springy, heath-grown basin we found (1903) harness, sleds, bottles, dishes, all sorts of wearing apparel, scattered bones of dogs and horses, ravens shot while on scavenger duty, newspapers, playing-cards, cigarettes — all giving mute evidence of tragic collapse. From one end to the other we traced the abandoned trail by the soiled and dislocated heather and moss. Some unfortunates were buried by avalanches on the west side near the foot of a splendid unnamed waterfall on a great nameless river.

At Caribou Crossing I first met the Canadian Mounted Police, as fine and upstanding a body of young Scotsmen as ever came down from the Highlands at the call of MacDonald or Argyle. And Caribou was the center of operations of the devoted Bishop Bompas. When we were there, he was

absent, making visits of inspection over a district about as large as England and for the most part devoid of roads. His good wife told us of their tireless efforts in behalf of their varied charges. One winter, for instance, a serious emergency of some sort called the Bishop with a dog team to Hazelton, then terminus of the Grand Trunk Railway, four hundred miles distant and across trackless mountains.

### VIII. THE ST. LAWRENCE SYSTEM

The Mississippi, including the Missouri, is America's longest river, but more water flows in the St. Lawrence basin. The whole St. Lawrence system may be considered as including the entire flow of the Great Lakes, though the name St. Lawrence is used only for the portion of the system between Lake Ontario and the sea.

This great river system begins in the iron mountains of Minnesota, in a fine clear stream in which the trout delight. There it is called the St. Louis River and it empties into the upper end of the great basin which makes the largest lake in the world — Superior. Coming out of this basin, it plunges down a rocky staircase and forms a waterfall that bears the name of Sault Sainte Marie, French words meaning the Leap of St. Mary — a name given by the explorers from France who came here in the early days. Wherever the French *voyageurs* went they left French names; and being Catholics, they also left the names of saints.

On either side of the Sault Sainte Marie (commonly shortened to "the Soo") a ship canal has been dug, and large vessels enter it by means of locks. Once when Dr. Jordan was in that region, a ship struck the upper lock on the Canadian side with great force. The blow broke open the lock, and Lake Superior suddenly tried to rush through the canal. It took about a minute for the vessel and its passengers to get to the foot of the rapids, but it took a good

many weeks for workmen to repair the break with brush, straw, and sacks of earth, filling the opening in the dam.

Below Sault Sainte Marie and St. Marys River come Lake Michigan and Lake Huron. As you have read in an earlier chapter, Georgian Bay on Lake Huron is really a series of depressions among the granite knobs that the moving glacier left rounded and smooth, as it made its way over a multitude of islands.

The stream that runs out from Lake Huron is clear and swift. It is known as the River St. Clair, and soon spreads out into a shallow depression noted for its black bass. This is Lake St. Clair. Out of Lake St. Clair flows the Detroit River, which passes down into Lake Erie. And from Lake Erie comes a swift stream, swifter than the others but almost as clear, the Niagara. The Niagara flows over a limestone ledge, making the magnificent double falls, and enters a lake about the same size as Lake Erie and a little deeper, Lake Ontario. And the overflow from all these lakes makes the St. Lawrence River.



Locks at the Sault Sainte Marie from the American side.



The St. Lawrence River at Quebec.

Clear and beautiful, the St. Lawrence starts out and moves past a group of islets known as the Thousand Islands, which are knolls between depressions worn down by glaciers, like the islands in Georgian Bay. Then the river grows deeper and swifter as it flows to the northeast, and near Montreal passes over granite rocks, forming the Rapids of Lachine. From there on the river spreads wider and wider as the tides enter it from the Gulf of St. Lawrence. Near its mouth a number of swift streams enter the St. Lawrence, one of them, the St. Anne, having a lovely waterfall. Another, the Saguenay, is a very deep river famed for its splendid scenery and for the tremendous granite cliff that is called Cape Eternity.

Following the course of the St. Lawrence system, you have seen that the Great Lakes lie in terraces or steps. There are five of these, Lake Superior being some six hundred feet above the level of the sea; then comes Lake Huron, twenty feet below Lake Superior. Lake Michigan is on a level with Lake Huron, both being five hundred and eighty feet above sea level. Next comes Lake Erie, nine feet lower, and Lake Ontario, which is over three hundred feet lower.



The Welland Canal from Lake Erie around Niagara Falls to Lake Ontario is navigable for large ships, thus making navigation possible from Duluth on Lake Superior to Montreal and Quebec. The wheat of Minnesota and the copper and iron of Michigan and Minnesota can be shipped down the St. Lawrence and across the Atlantic, which means that the products of this region can be carried by water all over the world. The remarkable shipping facilities have had much to do with enriching and developing the Great Lakes region, and building up the cities of Chicago, Detroit, Toledo, Cleveland, Erie, Toronto, and Buffalo, as well as many other busy and prosperous places along these lakes.

## CHAPTER SEVEN

### A STORY OF EROSION

#### I. ROBBER RIVERS

WE do not think of a river as a thief, but once in a while, in a mountainous country, a stream cuts through and steals the waters from its rival on the other side of the divide. This is justly called by geologists a case of robbery. An interesting example of a robber river may be seen near Alleghany Spring in Virginia, where a small branch of the Roanoke has kept tearing out the sides of its banks until it has cut through to a branch of the New River, a tributary of the Ohio. By working farther and farther toward the west, it has finally taken one of the streamlets which ought to go to the Ohio. It took not only the water; it took the fishes also. And so we find in the headwaters of the Roanoke small fishes that belong farther west.

The gnawing and cutting of water at rocks and soil, whether it is done by rains or by a stream flowing through a country, is called erosion. All streams erode. They pick up bits of earth and rocks along their banks and bear them to the sea or deposit them along their beds.

Denudation, which means making bare, is erosion on a large scale, combined with the work of frost, wind, and other eroding agencies.

Once upon a time the headwater erosion of a group of rivers almost caused a war between the South American countries of Chile and Argentina, because the streams flowing to the Pacific cut back toward the east and took water that hitherto had gone to the Atlantic. The robber rivers thus changed the boundary between these two nations, shifting it toward the east — that is, toward Argentina. So

a great deal of diplomacy had to be exercised before a new boundary was agreed upon and a conflict averted.

## II. NATURAL BRIDGES

Bridges are sometimes made by the erosion of rivers — natural bridges carved out of solid rock.

In the west-central part of Virginia near the city of Lexington there is a clear little stream running down through a glen between tree-covered hills. The lower rock layers of these hills are of rather soft slate, but the upper ones are of hard limestone. The water cut its way through the slate without breaking through the overlying limestone, and left what is known as the Natural Bridge.

In the softer rock under the bridge, many men and more boys have carved their names. The name that stands highest of all is said to be that of George Washington, who knew this bridge when he was a boy.

For a great many years, almost from the first settlement of our country, the Natural Bridge of Virginia was believed to be the largest and most remarkable rock arch in America. But in 1916 people found out that was not the case, and it was through Mrs. John Wetherill, wife of a noted Arizona guide, that this came about. Mrs. Wetherill has lived on the Navajo Indian reservation in northern Arizona for a great many years. When she first went there, she learned the language of the tribe with such ease that the Red Men believed she must be part Indian, and gave her their friendship and confidence.

One day Hos-ke-ni-ni, the old chief, grew very ill. The time had come for him to go to the Happy Hunting Ground, so he sent for Mrs. Wetherill.

"I leave my people in your care," he said. "I know you will be good to them."

Mrs. Wetherill promised to help the Navajos in every way, and when Hos-ke-ni-ni died his people acknowledged her as



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The Natural Bridge of Virginia. Once this stream was entirely underground, and there was not even a gorge, only a cavern in the rocks, through which the water flowed. As time went on, the rocks above the cavern gave way and fell into the stream bed—all except this small portion of the roof which makes the bridge of today.





Rainbow Bridge of Utah; Non-ne-zo-shi, Bridge of Winds, as the Navajo Indians call it. They believed that it was made by the Great Spirit blowing many-colored winds from the tips of his fingers.

their leader. Ever since that time they have taken their troubles to her, and she settles their disputes and transacts their business with the government officials at Washington. The Indians have so much affection for this white woman that they trust her with all their secrets and call her Ne-he-zo-nie, which means Guardian Mother.

In the country north of the Navajo reservation, beyond the Utah border, trappers and hunters had discovered several natural bridges, spanning the upper reaches of the Colorado River and the San Juan River; and as word of these arches went forth, many tourists traveled across the Arizona sands that they might visit them. One day an old Navajo said to Mrs. Wetherill, "Why do white men always go to the Colorado River and the San Juan?"

Mrs. Wetherill told him it was because there were bridges there that they thought very strange and wonderful.

"I can show you a bridge that is like the colored arch of

heaven," the old Indian said. "It is many, many times as large as the ones they go to see, and far more beautiful."

Some months later the old Navajo guided a party of explorers into an almost inaccessible mountain region, and there, like a rainbow of stone spanning a canyon, glorious in coloring and beautiful in form, they found the arch about which the Indian had told. But he would not go near it.

"Non-ne-zo-shi!" he exclaimed, "the Bridge of Winds!"

Then he told them the following story.

When the Great Spirit made the world, he blew from the tips of his fingers winds of many colors — red, purple, amber, vermilion, orange, blue, and white — and as they went out from his hands they formed an arch like the rainbow. Then he told them to harden and stand still, and ever since that time the bridge has stood there. That is why Navajos call it Non-ne-zo-shi, Bridge of Winds.

When this arch of stone was measured, it was found to be the largest natural bridge in all the world, high enough to span the dome of the Capitol at Washington. White men call it the Rainbow Bridge, because it is not only shaped like the rainbow, but colored like it too, the sandstone rock that forms it being of almost every shade of red, green, blue, orange, and purple, with broad strips of white. They know its mighty arch was hollowed out by the water; but the Navajos still speak of it as Non-ne-zo-shi, the Bridge of Winds, and believe the Great Spirit made it by blowing from the tips of his fingers winds of every hue.

### III. CUMBERLAND GAP; CUMBERLAND MOUNTAIN AND CLINCH MOUNTAIN

When Daniel Boone, the famous hunter and Indian fighter, and other bold spirits went from the country that lay east of the Appalachian ranges and founded the state of Kentucky, they passed through the mountains at Cumberland

Gap. This is a pass across the Cumberland Mountains at the point where Virginia, Kentucky, and Tennessee meet. It is a depression in the range, wall-like on the south side.

The pioneers who crossed the Gap in the early days moved west over an Indian trail that until then was unknown to white men. As time passed, this trail became widened into a road, and over it went hundreds and thousands of pioneers who settled the central states and started the great development of the West. Theodore Roosevelt described them as "an army of fighting settlers, who with ax and rifle won their way from the Alleghenies to the Rio Grande and the Pacific." They were far more than pathfinders, hunters, and Indian fighters. They were makers of the nation, for without their courage, their willingness to endure hardships, and their dream that their children and their children's children might have pleasanter lives than theirs, America would not today be the great country it is. It is interesting to remember that many of these courageous pioneers made their way westward through Cumberland Gap.

South of Cumberland Gap there is a remarkable example of erosion—the transformation of a former mountain ridge into a valley about thirty miles wide. On one side of this valley is Cumberland Mountain, and on the other side Clinch Mountain, each being a long, even ridge with steep walls on the side toward the valley and a gentle slope on the other side. Between these two flow the Clinch and Powell rivers. The Clinch, after taking in the waters of the Powell, flows southwest and joins the Tennessee River.

Long ago the space between Cumberland and Clinch mountains was not a broad valley but a high rounded mountain fold. This high ridge was then capped with hard sandstones, like Clinch and Cumberland mountains; but the rains sent their floods of water down upon the region, and the streams, ever carrying away mud and sand,

kept eating away at the higher parts. After a long, long time the mountains were worn down to a plain, overtopped by the high ridges of Cumberland and Clinch. Soft rocks were exposed where the mountain fold had stood, and the streams cut down this soft rock more easily than the hard sandstones that sloped down over Clinch and Cumberland mountains. Thus a broad valley was carved out, leaving these two elevations standing on either side.

The rocks of Cumberland Mountain all slant toward the northwest, and the surface rock is a thick, heavy sandstone which protects the strata underneath it from the rain. Clinch Mountain is of the same form and composition as Cumberland Mountain — hard, slanting sandstone above the softer rock — but the slant of the rocks is in the opposite direction from that of Cumberland Mountain, southeast instead of northwest.

#### IV. THE UNCOMPAHGRE PASS AND THE GARDEN OF THE GODS

In the western part of Colorado above the city of Ouray is an imposing amphitheater of red rock, and above it is one of the finest of mountain passes, the Uncompahgre. Through this pass the Uncompahgre River plunges down a wild gorge, which you may view from a narrow stage road cut in the solid rock high above the river.

The Uncompahgre River is one of the tributaries of the mighty Colorado River. It pours its waters into the Gunnison, which in turn joins the Colorado. The Gunnison River rises in broad upland meadows and makes its way through what is called the Black Gorge of the Gunnison. Below this gorge it plunges into the ground for a distance, and then the swift stream rises again as from a spring. There were once two bold explorers who were determined to see the whole course of the Gunnison. They plunged





In the Garden of the Gods, Colorado; a view of Cleopatra's Needle (the sharp spire) and the group of rocks known as Cathedral Columns (at the right).

under the rock wall with the river and came out safely on the other side, a piece of good fortune that was perhaps hardly to be expected.

Southward from the upper end of Uncompahgre Pass flows the Rio de las Animas Perdidas, the River of Lost Souls, sweeping through a chasm carved in the black rock that a long time ago flowed out as lava. Around the summit of the pass cluster mines of gold and still rarer metals. All in all, this region is a wildly romantic place, as well as one of great interest to the geologists.

In the heart of a mountain region in the central part of the state of Colorado, about three miles west of Colorado Springs, is a celebrated mountain park known as the Garden of the Gods — a most striking example of erosion. Here are some five hundred acres of red sandstone rocks

fantastically carved by the water. As one approaches the park, one sees a red mass rising like perpendicular walls with a narrow passage between them, forming a majestic gateway. Beyond the passage are rocks of many different sizes and shapes. Some, because of the work of erosion, look like fishes, seals, or cats; some are like sphinxes or cathedral columns; while still others are sharp, gracefully proportioned spires. And because all are bright red and they stand against the background of Pikes Peak, the Garden of the Gods is a place of striking beauty.

## V. THE GEODES OF ILLINOIS, IOWA, AND INDIANA

Along the Mississippi River, in eastern Iowa and northern Illinois, are great beds of very old rock, called Mississippian rock, that were formed there before the period we call the Coal Age. This rock elsewhere passes under the coal measures and is therefore older than the coal. One of these beds of rock is known as Keokuk. Wherever streams have cut down into the earth so that Keokuk rock now appears at the surface, you will find in it hollow balls of quartz called geodes.

Geodes are nearly round, hard, and rough on the outside, greenish and whitish in color, and they vary from the size of a cherry to that of a big pumpkin. If you break one open, you will often find within it a cavity with crystals of white quartz, each with a six-sided, pyramid top. Sometimes, instead of quartz, they contain crystals of calcite or other minerals. These geodes were once filled with water, and very, very slowly the mineral particles contained in the water solidified into crystals.

Sometimes there are no crystals inside a geode, but the quartz within them is rough and cloudy looking and lies in wavy layers. The crystals of quartz are generally clear,



A geode broken open, showing large white crystals of both quartz and calcite within the cavity. The walls of the geode itself are composed of quartz.

but sometimes they are stained violet with salts of manganese. Then they are called amethysts.

The geodes, in many cases, fill cavities in rocks where sea animals died in the prehistoric times when these rocks were forming. Some of these creatures were probably masses of sponge, but sometimes we find that a geode is the head of a crinoid, or stone lily, and sometimes a shellfish that has become petrified, or turned into stone.

In the state of Indiana, around Bloomington and Bedford, there is a layer of Keokuk rock filled with geodes. We can find them by the thousand in Iowa or Illinois in the bed of almost any stream that cuts into the Keokuk rock, which lies along the line of the Mississippi River. There is Keokuk rock on the brink of the Grand Canyon of the Colorado, but the geodes in this are very small, mostly about the size of cherries, with sparkling little crystals inside.

## VI. THE BAD LANDS

Along the upper courses of the Missouri River and its tributaries, in the states of South Dakota, Montana, Wyoming, and Nebraska, lie the Bad Lands, a maze of gullies and ravines very hard to cross. This region was therefore called *mauvaises terres*, meaning Bad Lands, by the early French *voyageurs*. These Bad Lands have been carved into fantastic shapes by the rains and the erosion of rivers so that, viewed from a distance, some of them look like castles with buttresses and towers. This is especially true of the Hat Creek Basin of Nebraska and the Big Bad Lands of South Dakota.

Quicksands are one of the things that have made these regions dangerous for man and beast. A quicksand is composed of grains so smooth that they have scarcely any friction. An animal or a person stepping on it will sink and find nothing solid to keep him from falling, almost as if he were in water. Such sands are scattered over a good many parts of the world. When Dr. Jordan was once riding a horse up the coast from Santa Barbara, California, in fording a little stream the horse stepped into a wet quicksand and began to go down. But as the stream was narrow, the rider was able to leap from the animal's back to the farther side and then to pull him out by main strength.

Soft mud and quicksands often abound around springs which have salty waters. To these salt springs the beasts of the past used to come. Many of them sank in the quicksands and perished there, and so today, in the soft soil around the ancient salt springs, we find bones of the great elephant called the mammoth, the mastodon, and other gigantic creatures of long ago. And with these are deer of different kinds, buffalo, elk, and the like, all trodden into the mud and quicksand, those that fell first being trampled by the ones that came later. In Kentucky there is a spring called





The *mauvaises terres*, or Bad Lands, of Nebraska and South Dakota. The region shown in the photograph lies north of Scotts Bluff, Nebraska. Here the soil is very poor and supports no vegetation; consequently the rains have nothing to hinder them in their work of wearing down the land. Every storm deepens these gullies and carries off great quantities of sediment.

Big Bone Lick, where animals used to come to lick the salt, and where hundreds of them lost their lives.

The Bad Lands are cemeteries of the past — cemeteries where we find the fossils of animal species that are no longer living. A fossil is a relic of some once-living thing, buried by natural causes. It may be bones, a shell, teeth, scales, tracks, or wood — mostly hard parts, though delicate leaves may also be outlined in fine sediment. Sometimes a fossil may become petrified because water containing silica has very slowly filtered in, until the silica bit by bit replaces the original material. Soft parts never petrify.

Among the strange fossils of the Bad Lands is a little horse not bigger than a fox terrier, with four toes on each fore foot and three on each hind foot. Later on, horses gradually became larger and larger, with fewer and fewer

toes, until we come down to the horses of our times, which have only one toe and, buried under the skin, the splint-bones which are relics of two other toes. (See picture on page 264.)

The Bad Lands were a great refuge for the Indians, because the white men knew so little about this region that the Sioux and other tribes were comparatively safe there. They used to sally out from their fastnesses to drive away the cattle of the settlers and hide them in the deep gullies which the rivers and rains had cut. According to the Indians' idea, the palefaces were trespassers in territory that rightfully belonged to the tribes, and because the Red Men were determined to drive the newcomers out, the Bad Lands were the scene of many encounters between Indians and United States troops. The early history of this region of gullies and deep ravines is largely on account of uprisings led by chiefs who believed that in striking at the whites they were doing their duty to their own people.



Photograph of the leg bone of one of the huge animals that lived in the age of reptiles, lying just as it was discovered in South Dakota. This reptile, called Triceratops, was probably twenty feet long and at least ten feet high at the hips. Fossil bones of Triceratops are abundant in the central part of South Dakota.

## VII. THE GRAND CANYON OF THE COLORADO

The most remarkable example of erosion in the whole world is the Grand Canyon of the Colorado in northwestern Arizona.

Ages ago, after the region that is now the southwestern part of the United States had risen from the sea, a great uneven plateau was formed in northwestern Arizona. Over this plateau flowed rivers which, as time went on, cut down their channels and widened their valleys. The softer rocks were cut away more rapidly and the hard rocks less rapidly, and thus were formed the platforms, promontories, natural temples, and sheer walls that one now sees at every turn.

As century after century passed, the most powerful of these rivers worked down to a layer of very hard rock, in which at first it could cut only a rather narrow channel. But slowly, unceasingly the stream carved its way down, and as it went deeper and deeper, it formed a gorge with abrupt walls. For ages the river continued to saw through many different rock layers, until a mile of vertical depth was washed away. Thus was formed the most marvelous gorge the world knows, a place of stupendous beauty and weird magnificence, unlike anything else upon our globe.

Inside this great canyon are ridges and peaks high enough to be mountains themselves. The highest mountain in New England, outside the White Mountains, is not high enough to reach from the bottom to the top of the canyon.

The first exploration of the Grand Canyon was made by Major Powell, who with nine men set out in four boats in 1869 to follow the course of the Green River and the Colorado. They went through a long series of canyons, descending many great rapids. In the greatest gorge, the Grand Canyon, they did not know but that at any bend their boats might dash over a vertical fall; but they found that they could get around all in safety.



Looking down into the Grand Canyon of the Colorado from a point near Mount Trumbull. In some places the total depth of the Grand Canyon, from the top of the cliffs to the river, is more than a mile.





At the bottom of the Grand Canyon, showing the Colorado River near the foot of the Bright Angel Trail. This well-traveled trail is one of the few ways to the bottom of the canyon, and even this path is "scary" in some places.

One day they came to an extremely muddy little stream cutting its way through a desolate region of bare rocks on the north side. This they named the Dirty Devil River. About two hundred miles farther down was a stream that was crystal clear. They named this the Bright Angel.

Two years later Major Powell, with ten men, again explored this wonderful waterway, this time for the United States government. They devoted two years to securing data for maps and other information.

When you go to see the Grand Canyon, you will find a great hotel and a settlement above the river on the south rim, opposite the beautiful Bright Angel River. You can go down into the canyon over a narrow, winding trail, and the burro you ride will walk so close to the outer edge that you may be frightened. But the burro knows what he is doing, for if he keeps close to the outside, especially if he

has a burden on his back, he is less likely to be shoved off into the abyss.

There was once a famous guide from Tennessee named John Hance, who was known throughout the canyon region for his fanciful stories, not all of which could be taken as literally true. A few miles above the Bright Angel there is an especially fine outlook called Grand View. One day when Dr. Jordan was there, Hance showed him the bones of a horse on the rocks a mile below and told him the following story. He said that, years before, when the Navajos roamed these forests, they chased him to the edge of the canyon. To turn back meant death; to go forward meant equally great risk, but he had to do something. So he struck his horse with his whip and the animal leaped into the canyon. About six feet from the bottom, he had the presence of mind to leap from the horse and save his own life. But the faithful horse met death, and his bones could still be seen. This you may believe if you can, though it does not agree with the accepted law of falling bodies.

The Indians say that the Grand Canyon of the Colorado came into existence through the grief of a chief who mourned over the death of his wife and would not be comforted. This is the story they tell about it, as under the light of the desert stars the children listen to the tales of the wise old men.

One day as Umba, the chief, sat grieving by the door of his hogan (their word for house), the god Ta-vwoats appeared and spoke his name. "Thy beloved is happy in a land to which I will take thee," he said. "Come, that thou mayest see for thyself. But first I must have a promise that upon returning thou wilt no longer mourn for her."

The chief gave his word and Ta-vwoats led the way, cutting a trail through the mountains that guarded that far western land, a trail deep and narrow, that led from the place of the living to the place of departed spirits. Together they

followed it and by and by reached a region lovelier than any upon all this earth. There the chieftain saw his squaw, happy among thousands of other happy ones in a realm of sunshine, warmth, and peace.

A long time he looked upon the scene. Then he smiled and said, "I will go back and mourn no more, because I know a day will come when I shall be with her there where all is gladness."

So they returned through the long, deep channel, which is the great canyon of the Colorado. Ta-vwoats made the chief promise he would tell no one of the marvelous region he had beheld, because those who heard of it would surely want to hurry away and dwell there. Then the god rolled a river into the gorge, a raging yellow stream that would swallow up anyone who attempted to make his way along it, and that rolls there to this very day.

### VIII. THE MESAS AND BUTTES OF THE WEST

Scattered throughout Utah, Colorado, Arizona, and New Mexico are many flat-topped hills or areas with more or less steep sides and hard upper layers of rock. These were called mesas by the Spaniards, who were the first white men to come into this region, *mesa* being the Spanish word for table.

Mesas are the "left-overs" of widespread erosion or denudation, where the surface rock was harder than that below. Mesas vary in size from those a few hundred yards across to those containing thirty and forty square miles and even more. Along the sides of some of them the ancient inhabitants whom we know as Cliff Dwellers made their homes.

Farther north, in Montana and elsewhere, the name *mesa* gives place to *butte*, a term which is not limited to flat-topped hills. The Spaniards were not the first white people



A typical mesa dominating a desert landscape in Arizona. The top of this mesa is composed of a hard rock which resisted the wear of erosion, and thus it remains standing above the surrounding country. In the foreground may be seen a cluster of prickly pears, or *Opuntia* (a species of cactus).

to come into that region. Frenchmen explored it, and they used a French word, *butte*, which means almost any small mass of high ground.

## IX. UNDERGROUND EROSION; LIMESTONE CAVES

Where rivers flow underground, they cut away the rock as they move along, just as they do on the surface. Sometimes when they come to limestone, which will partly dissolve in water, these subterranean streams carve out caves and grottoes with passages that look like castle halls and cathedral aisles. A cave is usually the track of an underground river. From some of these caves the water is entirely gone, drained away to lower channels; but in some the rivers that formed them are still flowing.

Usually from the roof of a cave there are great icicle-like



projections known as stalactites. These are formed from the droppings of water containing carbonate of lime, which the water took up as it passed through the rock. And it sometimes happens that water dropping from stalactites deposits along the floor the lime it contained, and forms shorter and wider masses called stalagmites. Both stalactites and stalagmites originate in the same way, being built of lime contained in dropping water. But stalactites jut downward from the roof of a cave, and stalagmites extend upward from the floor. Sometimes stalactites and stalagmites become so long that they join and form pillars. In some caves these pillars stand in a row and look like the pipes of a huge organ.

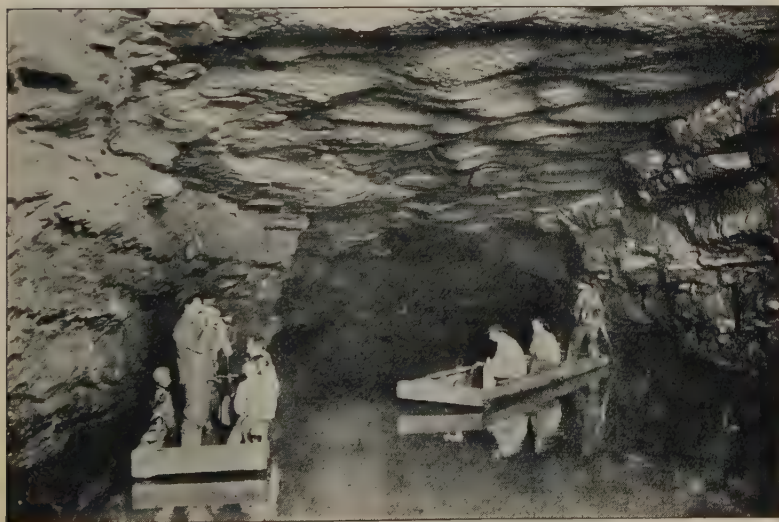
Now and then, as the water works its way underground, it tears away the sides of a cave, and the roof falls in. This leaves, not a cave, but an opening into the ground called a sink hole. A sink hole is simply the failure of a cave, or one which has gone out of business.

All limestone regions are full of caves. In northern Kentucky and southern Indiana, in southern Tennessee and Missouri, as well as in Virginia where the rock is largely limestone, there are a great many caves. The most noted of all is the Mammoth Cave in Edmonson County, Kentucky, about seventy-five miles southwest of Louisville. This is especially interesting because it is still traversed by its own river, the Styx, named from the stream in Greek mythology that is supposed to flow through the region of departed spirits.

When first discovered, a little over a hundred years ago, the Mammoth Cave was called the Bottomless Pit. It was said to be haunted by demons and for several years people were afraid to venture near it. Then one day a man pursued by the Indians was forced to take shelter in the cavern. He stayed there all night without anything terrible happening to him, and the tales he told of wonderful sights within

made others so curious about the place that they explored it. It was found to contain saltpeter in considerable amounts. This was taken out and used in the manufacture of gunpowder during the War of 1812, so the cave has had its part in the making of American history. The Mammoth Cave has not been explored in all its branches, but men have gone through so many of the passages that we know it is ten miles in extent and contains more than two hundred miles of avenues, channels, pits, and domes. One of its grottoes, called the Temple, is over five hundred feet long, about thirty wide, and a hundred and twenty-five feet high. It must have been used as a place of worship by Indians or some prehistoric people, for in it have been found a number of implements such as primitive tribes use in religious ceremonials.

Another great cave is the Wyandotte in Indiana. Dr. Jordan once went far into this cave with a group of friends,



Listening to the echoes of Echo Lake on the River Styx, which flows across Mammoth Cave, Kentucky.

who, after walking a mile or two, began to turn back. Advancing ahead of the others, he thought it would be interesting to see how absolute darkness looked, so he blew out his candle and sat down on a rock which he knew his companions must pass. But in the darkness he fell asleep and did not awaken until the last glimmer of light was moving along the passage ahead of him. This gave him an opportunity of seeing perfect darkness. There was not quite perfect silence because water was dripping from overhead. He found it impossible to get out through the narrow and bewildering passageways without a light, as he could not keep his directions for any length of time. And it did not take him long to decide that he could not make a light by rubbing a handkerchief and a candle. So he felt along the floor of the cave until he found the print of a woman's shoe and the direction in which it was going. He was sure some of the party would return that way and after three or four hours they did. He was glad to have found out how perfect darkness looked, but does not care to try the experiment again.

In the valley of the Shenandoah in Virginia, not far from the town of Luray, is another great limestone cave. This is especially interesting because of the whiteness of its stalactites and its walls. It was made in the same manner as the Mammoth Cave and the Wyandotte Cave, by an underground river working its way through limestone rock.

There are many other caves in different regions and all that are of any importance were made in the same way. Into some of these caves rivers flow and never come out, draining away lower and lower into the ground. But from some caves the streams flow out again. In Kentucky, the Round Stone River sinks into a cave to come out some miles below as a tributary of the Rock Castle River. Dr. Jordan once explored the Round Stone Cave for a distance. After getting well into the cave, he came to a mass of clay, which



The "King's Palace" in the Carlsbad Cave in southeastern New Mexico. In a strong light the stalactites and stalagmites reveal their fantastic shapes and are often very beautiful.

was piled up in the water. Climbing over this pile, he looked down on the other side. The light of his lantern went out as he slipped over the bank in the darkness. When he struck the river, he found the water three feet deep. So he waded back to the pile of clay and made his way around it and out of the cave, and never attempted to explore the Round Stone any farther.

In 1920 and the next few years the United States government was having trouble along the Pecos River in New Mexico. Dams built for storing water for irrigation proved to be of little use, because almost as soon as the water was collected there it disappeared underground.

So the United States Geological Survey sent Dr. Willis T. Lee to the Pecos country to learn the cause of the river's



strange behavior. He found that the strata of that region are composed largely of limestone, rock salt, and gypsum, which are soluble in water. The river water simply dissolved this material and disappeared underground instead of remaining on the surface. During the course of his investigations Dr. Lee made an amazing discovery. As he traced the rock layers bordering the Pecos back to the foothills of the Guadeloupe Mountains, he located about twenty-two miles southwest of Carlsbad a cavern with stalactites and stalagmites of extraordinary beauty. Robert A. Holley, of the General Land Office, later surveyed this cave, and found that one of its chambers is half a mile long, several hundred feet wide, and has a ceiling so high that it cannot be seen by the light of the torches. Beyond this great chamber are still other rooms, perhaps as large, or even larger than the first one. The Carlsbad Cavern has been only partially explored, but enough has been found out about it so that we know it is one of the greatest, if not the greatest cave in the world, and by a Presidential proclamation of October, 1923, it was made a national reservation.

Dr. Lee later spent many months in explorations of this and other Guadeloupe caverns. It is believed that the entire lofty mountain range, which is of solid limestone, is honeycombed with vast caverns, some of which may be even greater than Carlsbad.

In the limestone caves of Kentucky lives a species of blind fish, evidently descended from the fish of the Lake of the Dismal Swamp. In Wyandotte Cave in Indiana there lives another species of blind fish; in the caves of Missouri there is a different kind, and in Illinois still another. The fish that went into one cave did not mingle with those that went into another, because after they once got in they stayed there. So through the ages the fish in the various caves became distinct from each other, although all of them are blind. All these species of fish have come down from a

past geological period, and except from the streams in the caves and from the Lake of the Dismal Swamp and similar waters farther south, all of their kind have disappeared.

In these caves are also other blind creatures, salamanders, crayfish, crickets, and the like, and in the mouths of the caves are thousands of bats. Bats like to sleep in the daytime, hanging to the wall by one leg, head down. In the shadows at the mouths of caves they can keep out of the way of all tormentors.

## CHAPTER EIGHT

### THE GREAT DESERT REGION

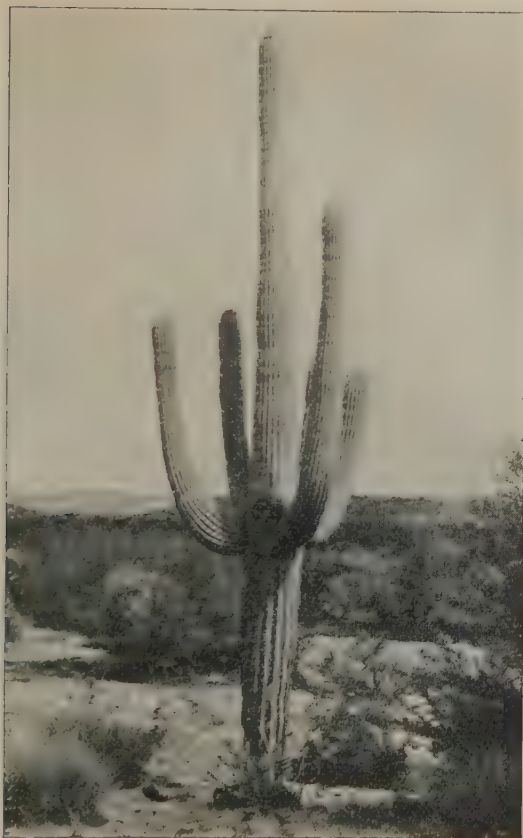
#### I. THE VEGETATION AND LIFE OF THE DESERT

FAR down in southwestern Arizona is Yuma, a town surrounded by shifting sand. Yuma is in the desert country and is now a railway station of some importance, but in the early days it was just an outlying army post called Fort Yuma, where troops were stationed to guard our southern frontier.

To the southeast of Yuma is the great Gila Desert. This is a region of miles upon miles of yellow sand, with low mountains rising above it like crimson and saffron cushions, and except for a few scrubby cedars and mesquite and the giant cactus, scarcely a tree greets the eye. Some writers have called the desert "the country God forgot"; but the Indians and the whites who now live there believe it to be one of the most beautiful spots upon the earth.

Besides the Colorado and Gila deserts, there are other vast tracts of arid land in the western and southwestern part of the United States. Indeed, a considerable portion of New Mexico, Arizona, Utah, Nevada, and some tracts in Idaho, Wyoming, and California are regions of sand or lava. To the pioneers who journeyed westward after the discovery of gold in California, it seemed that the burning waste lands were so far reaching they would never get beyond them. Even now, with our fast trains, it takes a night and almost two days to cross the desert, although the arid region of our time is much smaller than was that of the gold-seekers, because in hundreds of places water from streams has been carried to it, transforming it into farming country. But it is still so large that about two thirds of Europe, outside Russia, could be set within its borders.

In the desert region of America grow strange plants,



The giant cactus, on the southern Arizona desert.

wholly unlike the ones that are found in lands of forests and green meadows. Strangest of all these plants are the many different kinds of cactus. The Papago Saguaro is a giant cactus tree with fluted sides like a column, from which spring branches which become vertical, so that the whole thing looks like an enormous candelabrum. At the top of the column grows a cluster of white flowers, and people say the fruit is very good eating, but we have never climbed up to find out, for the trees are covered from top to bottom with



thorns an inch long. The woodpeckers bore holes in its sides and sometimes fill them with nuts if they can get any, which is not easy in a land where the only nut-bearing trees are scrubby pines and a few oaks. Little owls often make their way into these holes. In fact, the holes furnish admirable homes for birds that like that sort of place.

Besides the giant Papago Saguaro, there are many other forms of cactus. Commonest of all is the angular, branching



The Mohave Desert, California, showing desert vegetation. At the right is a Joshua tree, one of the yuccas, desert plants which have showy white flowers. The photograph shows an exploring party sent out by the United States Geological Survey.

cholla, covered with long white thorns and often very pretty. There are also the pincushion cactus, the hedgehog cactus, and various others, ranging in size from a little ball to a very big melon. Several species of cacti are made up of a series of flat joints. These strange desert plants have no real leaves; they have only the beginnings of leaves. But the blossoms that come upon some of them, red or yellow and formed like roses, are very beautiful.

The cactus has been called the camel of the plant kingdom, because it needs but little water and stores what it has. Animals and men suffering from thirst sometimes break

open a cactus and devour the soft inside. But it is not easy for any beast to get at the juicy parts of a cactus. Unless he has a mouth as hard and dry as an owl's, he cannot crush even a small piece of this desert plant without spending the rest of the day getting the prickles out of his nose.

The many forms of cactus are all natives of the warmer parts of America. A few little ones grow in the North as far up as West Point on the Hudson and in southern Idaho, but most of them collapse when attacked by the frost. The fruit of some of them is very delicious, although too well filled with hard, shotlike seeds to be really pleasant eating. One species has been carried to Europe, and its fruit, red or yellow, is much in demand in the markets of Paris, where it is called *la figue de Barbare*, Barbary fig.

Luther Burbank, the famous botanist who has spent his life changing the nature of plants, has developed several kinds of cactus bearing delicious fruits, green, red, and yellow. From some of those with flat joints, called prickly pears or *Opuntia*, he has bred away the thorns so that the plant joints can be fed to cattle without danger of leaving thorns in their stomachs.

The ocotilla is not a cactus, but it is just as thorny as one. It grows six or eight feet high, the shape of a riding whip, hard and bony, and on the top it bears a lash or flag of bright scarlet flowers.

During most of the year the only water in the heart of the desert is in rare ponds which the wash of some cloudburst has filled. Because of this lack of water, the story of the Gila trail is a long tragedy, a tale of many human beings and animals who have lost their lives on this desert. Men and beasts cannot get along without water. They die when they do not have it, just as plants do.

On the sands of the desert live many lizards, some of which are as gayly colored as the cactus blossoms. Dr. Jordan once saw there a bright green chameleon with red



Airplane view showing how a former desert region looks after irrigation and cultivation. These farm lands at Idaho Falls, Idaho, have been reclaimed by irrigation. In many desert regions the land is very fertile and needs only water to produce abundant crops.

trimmings that was a joy to behold. The rascal was troublesome to catch, but he was finally captured and taken home, where he was fed upon flies and grasshoppers. But all the while the gorgeous creature longed for bigger insects with more spicy flavor — tarantulas, scorpions, and centipedes.

There is a lizard on the Gila Desert that is over a foot long, dull orange and brown, with a heavy skin covered with warts. This is the Gila monster, poisonous as a rattlesnake, although it is sluggish and will not move far to attack anybody. The Gila monster is the only creature of the lizard class that has venom in its mouth. All the other four-footed reptiles, from the smallest lizard on a tree up to the largest

crocodile, are harmless so far as poison from their bite is concerned.

Except where water has been brought from the mountains, few people live on the desert except Indians and miners searching for gold, silver, or other metals. During the day in summer the heat is so intense that the little Indian boys squat on the ground too listless to move, wishing for night to come, and the squaws nod over their baskets, not caring whether they work or not.

But the desert is beautiful at all times, especially in the early morning and evening, and no matter how hot the day, it is cool at night. Often there are picturesque mountains in the background, with an amazing range of light and shade at nightfall. For a little while in the spring it is covered with flowers of yellow, blue, white, and red — poppies, marigolds, and many other plants, besides the cactus and ocotilla.

## II. THE STAKED PLAIN

All over the western arid region, from Texas through to California and north to Montana, Wyoming, and Idaho, are strange and interesting places as different from those of the garden-like valleys of the East and the Pacific coast as they can be.

In southeastern New Mexico and in the northern part of Texas, which people call the Panhandle, lies the Llano Estacado, or Staked Plain, so named from the steep palisades shutting it in like a stockade. This is a region broken only by a few rivers. Because the rainfall is very scant, it is covered with desert plants, cactus, greasewood — a green shrub with a prickly stem — and many other growths characteristic of a dry, hot country. During part of the year fine grass springs up, serving as excellent food for cattle, but after the rains have ceased, this vegetation dries up and the herds have to be driven away.



Through the Llano Estacado passed what the western cowboy calls the great cattle trail. In the days before the Civil War, and for a good many years after it, when there were few railroads and herds had to be driven to market, the cattle of Arizona, New Mexico, and Texas were taken northward through the Indian Nations (now Oklahoma) and through Kansas, to the trade centers along the Mississippi and its tributaries. Kansas City, Omaha, and St. Louis were established in the early days as cattle markets, and were developed by the stock industry into important cities. Over this great cattle trail millions of hoofs have tramped. Often, as they moved along, the Indians of the Southwest — the Comanches, Apaches, and Navajos — attacked the cowboys and their herds, and many thrilling tales of those days cluster around the plains.

Originally the cattle of Texas and the Southwest came across the Rio Grande from Mexico, being driven northward by herders following the Mission Fathers. It was more than three centuries ago, long before the Franciscan missions were founded in California, that these dark-robed Spanish priests went into the desert, taking their lives in their hands and suffering all manner of hardship.

They began preaching to the Indians along the trails they followed, and wherever there was a large village of Red Men they started a church. The oldest of these missions was established in 1598 at Santa Fe in New Mexico. Before many years passed, a chain of missions extended across New Mexico and Arizona. That is why Spanish names are found throughout the southwestern part of the United States, just as Dutch names linger along the Hudson, and French ones in the Great Lakes region and westward — always names that preserve the language of the white men who first set foot there.

Close upon the heels of the friars came cattlemen with their herds to furnish meat for the settlements. Each



Ancient cliff dwellings in New Mexico, homes carved in the side of a cliff by prehistoric people.

pueblo, as the settlement was called, was provided with "from thirty to fifty head of horned cattle," which were sufficient to supply all its needs. As cattle increased, the surplus animals were turned loose upon the plains and formed the beginning of the wild herds that for generations roamed over this region. So whenever you read in stories of the old West about Texas cattle or Arizona cattle, remember that these herds were descended from animals brought from Spain to Mexico and driven into our land to furnish food for the men at the first Christian missions established north of the Rio Grande.



The Pueblo of Acoma, where the Indians of today dwell in the homes of their forefathers.

### III. THE PUEBLO OF ACOMA AND THE ENCHANTED MESA

In the highlands of New Mexico and Arizona live the Pueblo Indians, who may be descended from the Cliff Dwellers, prehistoric people who made their homes in cliffs along the mountain sides. But nobody is certain about it, because these vanished tribes, who were among the most ancient inhabitants of North America, left little trace of their existence. There are only some scattered arrowheads and other objects, and remnants of their small towns, perched like birds' nests high up on the cliffs, out of reach of predatory tribes.

The principal pueblos that remain at the present time are those of Zuñi, Acoma, Moqui, Taos, Cochití, and Isleta. They are the oldest continuing towns in North America, for

in them the Pueblo Indians have lived for many hundreds of years, and very likely these communities have been inhabited ever since they were built ages ago.

The Pueblo Indians came by their name because they always lived in towns, or pueblos. When the other tribes of North America were more or less barbarous, they were well on the road toward civilization. They had permanent dwellings, around which they cultivated their fields, raising a kind of dwarf corn with kernels of light blue, and they had goats and herds of cattle.

The Pueblos used to have a legend of the wonderful cities of Cibola, where people were so rich that they made arrowheads of emeralds, removed sweat from their bodies with scrapers of pure gold, and put precious stones over their doorways. In some way an Indian boy reached the town of Culiacan, in Mexico, and told this legend to the governor there. The Spanish adventurers of Sinaloa became wildly excited, as men have ever been moved by tales of gold, and they organized an expedition to go north and find this wonderful region. After several companies had fared forth and returned without discovering any trace of the cities of Cibola, a famous leader named Coronado rode north from Culiacan with a band of cavaliers, a company as splendid looking as ever set forth on an expedition in the New World.

These adventurers roamed far over the plains of the Southwest, along the Gila River, and even to the brink of the Grand Canyon of the Colorado. They passed through the Pueblo Indian settlements of New Mexico, and seemed so beautiful to the childlike natives that they thought the strangers had come from heaven and called them "fair gods." As the soldiers wandered about, some of the horses broke away from them and roamed over the country. The Pueblo folk captured a few of these animals, and the others became the ancestors of the wild horses of the plains.

The Pueblo Indians built their villages upon the mesas,



which made ideal home sites for a tribe that needed protection from warlike neighbors. They built the houses of stone, held together by mortar of clay, in such a manner that they served for both residence and fortress. Narrow trails, almost inaccessible, ran up along the steep sides of the mesa, and the only means of entrance to houses were



Martin Valle, chief of Acoma in 1900.

ladders that could be drawn up whenever desired. From lookouts on the cliffs any approaching enemy could be easily seen. It was the custom of these Indians to drive their herds at night up into the shelter of the fort towns. All in all, these primitive Americans were as safe from attack and displayed as much skill in making themselves safe as did the French or German baron of the Middle Ages with his castle walls and towers and moat.

All the pueblos are interesting, but one of the finest is that of Acoma in New Mexico, which is perched on a great flat-topped table, or mesa, of bright red sandstone seventy acres in extent and 355 feet above the plains. It is a considerable village and has still a Catholic church that was established by the Spanish missionaries who traveled that



A young Moqui chief who was educated at the Carlisle Indian School and later returned to Acoma.

way some three hundred years ago, but in most ways is little touched by our type of civilization.

The houses constitute three solid blocks, all built of stone, and they were ancient structures when Coronado and his men explored that region. They were even then equipped with windowpanes, for although they had no glass, the ingenious folk who made them used selenite, a translucent

form of gypsum, found in the mountains of that region. Through these panes light could pass; and in the living rooms were tiny fireplaces to provide warmth. These early people seem to have planned for their every need. In one place on the rock the surface was excavated so as to form a large pool in which to collect rain water. This served as a community well. In some of the trails running down the sides of the mesa are still found objects of worship belonging to the ancient period before Coronado came with his expedition and before the mission was founded at Santa Fe.

To this day the Indian people of Acoma live very much as their ancestors lived. Down the mountain trail each morning the ponies, burros, goats, and cattle are driven to graze on the plains below, and at night they are brought back to the shelter of the town. The same patches of land bordering the little rivers that their fathers cultivated, they cultivate today. While the men till the fields, the women make blankets and pottery, much of which they sell to tourists. The pottery of Acoma, with its brilliant shades of red and its trimmings of black and white, is very handsome and is highly prized by collectors. No other Indian tribe has learned the art of making this pottery with white areas.

About three miles from Acoma, rising abruptly to a height of five hundred feet from the red level, is the Mesa Encantada, or Enchanted Mesa, called Katzímó by the natives. It is a flat-topped cliff with perpendicular sides, regarded as absolutely inaccessible. Like a mighty fortress, it towers above the plains, and no sound is heard on it save some bird call, for it has been deserted more than a thousand years.

The Indians have a legend that the Enchanted Mesa was once an inhabited town like Acoma, and that the only approach to it was an almost perpendicular trail. The story is told that one day when the men were at work in the fields below, a mighty cloudburst and lightning blast destroyed



The Enchanted Mesa, seen from the west.

this trail, making it impossible to go up or down. The terrified workers believed it was due to the wrath of the gods, and fearing to attempt to regain their homes, they left the few old men and women and little children who were on top of the Enchanted Mesa to starve there, and made a new home for themselves on the more accessible tableland of Acoma.

It was long believed that the Enchanted Mesa could not be climbed. Some years ago, however, it was ascended by Dr. William Libbey of Princeton University, who fastened a weight to the end of a rope, and by using a small cannon, shot it up over the top of the mesa. The heavy weight held the rope there and Dr. Libbey was hoisted up to the top, where the Indians said a village had stood. He found no trace of previous habitation, and because a thunderstorm was in sight, he climbed down before he had time to explore the place thoroughly.

Soon afterward the Enchanted Mesa was climbed again



by Mr. Fred W. Hodge of the Museum of the American Indian in New York, Major Pradt, a government surveyor, and others. These men brought with them five strong ladders, and by tying them together they were able to reach the top of the cliff. They found what seemed to be traces of old stone or adobe houses, everything but the foundation having been long since washed away by the rain. There were also a number of arrowheads, beads, and bits of pottery.

This mesa was climbed a third time by a party under the direction of Mr. Charles F. Lummis, a great friend of the Indians and a keen student of Indian affairs. Dr. Jordan and Mrs. Jordan were members of this party. The ladders which Hodge and Pradt had used the year before were secured, and holes for the bases of these ladders were dug with knives in the sides of the red rock. Thus the party climbed to the top of the mesa. On the summit they found just what Hodge and Pradt had recorded — vague traces of houses of adobe or stone, and beads and arrowheads, which showed certainly that Indians had been there, thus again verifying the old legend.

#### IV. THE MESA VERDE AND OTHER HOMES OF PRE-HISTORIC PEOPLE

There were Cliff Dwellers in Colorado as well as in New Mexico. In the southwestern portion of that state we find the Mesa Verde, the Green Mesa, so called because of the stunted cedar and piñon trees growing there, which make it seem like a garden in a region where growing things are few.

The Mesa Verde is one of the largest of the mesas, being about fifteen miles long and eight miles wide, and contains some of the best-preserved cliff dwellings in America. It is a solitary, flat-topped hill, in the sides of which are carved gullies so nearly perpendicular that, viewed from a distance, they look like ladders. These gullies are really small, rough canyons, each one of which was once the bed of a stream. In



The cliff dwellings of the Mesa Verde, which are among the most remarkable that have ever been discovered. This is known as the Cliff Palace.

niches in the sides of the canyons, the prehistoric people built their homes. They were not satisfied with crude buildings and caves such as housed most of the primitive peoples of the West and Southwest. With some sort of rude tools, they shaped stones into cubes, cylinders, and spheres, and ornamented them with designs; and with these stones they built structures that were pleasing to them. They built so well that, although earthquakes have many times shaken that region and the storms of countless centuries have beaten down upon it, their houses still stand.

It was not until 1893 that white men knew anything about the Mesa Verde, and then it was discovered by sheer accident. Two Colorado herders, hunting lost cattle one day, came to the edge of a canyon and saw along the cliffs on the other side what seemed to be a city with towers and walls. It was winter time. The snow had laid a covering over it as soft as ermine, and the sight was so fantastically beautiful that at first they almost doubted their eyes, for it was like a city of fairyland set there in the heart of the desert.

When the winter was over and the canyons were passable, the herders went back and explored the cliff. They found it to be a place of homes and temples for worship. Many relics lying about showed that the people who had once lived there had had an admirable culture; that they carved and painted and wove with real artistry. Then word went out concerning the Mesa Verde, and after a time Congress set it aside as one of our national parks.

In southern Arizona is another and very different relic of prehistoric people known as the Casa Grande or Great House. This consists of three stories on a massive foundation, all built of the cochise, or heavy clay, which underlies much of Arizona. It is a well-planned structure, with very low and narrow doors, some of which opened on the main floor. In that respect it is unlike the pueblo houses, which



Meteor Crater in Arizona. This crater was excavated by a falling meteor.

had no doors or windows on the first story. About the Great House stood numerous outbuildings, long since ruined, but still giving an idea of the considerable degree of civilization among those who constructed them.

Hidden away among the mountains of southern Utah and Colorado, and in northern Arizona and New Mexico, there have been found very many other relics of prehistoric people, several of which are larger than those of Casa Grande or the Mesa Verde. In fact, because of the numerous homes of ages past that have come to light there, the region where these four states meet is known as the Prehistoric Belt. Most remarkable of all these cities of the past are Ba-ta-ta-kin and Kit-Siel, each of which shows the same excellent planning and craftsmanship that distinguish the pueblo houses, the Casa Grande, and the Mesa Verde. In them have been found bits of pottery, beads, and curious stone carvings done by those who once lived there. Some of the walls are richly ornamented with picture writing.



Everything about these ruins indicates that the inhabitants had a well-organized family and civic life.

Archæologists — those who, by studying relics of the past, slowly decipher the story of ancient races — are trying to solve the mystery of these vanished dwellers of our western desert and mountain region. Perhaps some day the world will know whence they came and where they went,



Meteorite which fell at Cape York in Greenland, now in the American Museum of Natural History in New York. It is composed almost wholly of iron, and weighs over thirty-six tons.

or how it happened that they disappeared. Until that time comes, we can only admire the skill and thoroughness with which they built their homes and planned their lives, and wonder about their history.

#### V. METEOR CRATER : A STORY OF MINERALS FROM THE SKY

In eastern Arizona the Santa Fe railway crosses a weird gorge called Canyon Diablo or Lawton Canyon. There is nothing unique about this gorge. It is like many others in the mountains that were made by the wash of temporary streams arising from the violent thunderstorms and cloud-bursts characteristic of a desert country. But if you follow

Lawton Canyon towards the south and then turn away a little, you will find Coon Butte, or Meteor Crater, a round hill one hundred and sixty feet high. Within it is a circular, cup-shaped depression, like a crater. It has the appearance of having been made by the eruption of a volcano, and it was once believed that it originated in that way. But several geologists have examined the place very carefully, and their investigations showed that this hill with its cup-shaped depression was not due to volcanic action, but was probably made by a giant meteor that fell in this region centuries ago.

Meteors are spherical bodies of all sizes and are largely made of iron alloyed, or mixed, with nickel. They seem to be revolving around the sun in their own fashion in scattered masses, and whenever one comes into the atmosphere of the earth it takes fire, and we call it a shooting star.

Meteors are seen at any season, but between November eleventh and thirteenth the earth meets a larger number of them than at any other time. When one of them strikes our atmosphere, it is carried down to earth by the force of gravity, and if it is not too large, it is burned up on its way down. That is why the little meteors shine like stars and people call them shooting stars. When the remnants of a meteor fall to the earth, we call it a meteorite.

The meteorite that formed Meteor Crater was not consumed as it came down, but plunged into the earth, throwing up the rocks on every side, as mud rises when you throw a big stone into a mudhole. It raised the limestone and sandstone rocks where it struck to a height of a hundred and sixty feet above the level plain. Fragments of iron from this meteorite are scattered over several square miles in eastern Arizona.

Nobody knows how deeply the great mass was buried. A company has been drilling for it in the bottom of the crater, but without success. They have not yet found the chief

body of iron. It is possible that it has slipped sidewise under neighboring strata, or perhaps the great mass was dissipated as vapor by the tremendous heat engendered by the fall. The broken fragments, however, are treasured in all museums so fortunate as to have secured any of them.

We do not know when the great meteor fell. Geologists believe that it must have been upwards of eight centuries ago, because there are cedars growing on the rim of the butte which show an age of seven hundred years, and any trees that may have been there before the iron mass came down would have been destroyed by the disturbance attending its fall. We know only that standing out there in the desert is this mound with its crater, thrown up by the fall of a gigantic meteor that centuries ago descended from the sky.

## CHAPTER NINE

### THE WASH OF THE SEA

#### I. TIDES AND OVERFALLS

##### THE TIDES OF THE BAY OF FUNDY; TIDAL WAVES

TWICE each day, or every twelve hours, the surface of the ocean rises and falls. The sea rolls landward for six hours, then away from the shore for the same length of time, as if some giant were pulling it back and forth. There *is* a giant tugging at its waters, keeping them eternally in motion, and that giant is the moon.

The sun too has its effect upon the tides. When the sun and moon pull together, we have the highest or spring tides. When they are far apart, the lowest or neap tides appear.

The tide is modified in all sorts of ways by the form of the coast. Out in the open sea the tides are very low. In enclosed waters like the Mediterranean they are also low, because they are set off from the great wash of the ocean.

The highest tides in all the world are in the Bay of Fundy between New Brunswick and Nova Scotia, in Canada, where they rise to a height of fifty feet or more. The reason for this is the form of the bay, wide at the mouth and growing evenly narrower up to the very head. Moreover, the Bay of Fundy is a part of the Atlantic, instead of an inland sea like the Mediterranean, and so it is not protected from the great wash of the ocean. Into this bay the tide rushes, sometimes with a loud roar.

When the tide goes out, the sediment it has carried is left in the form of great mud deposits at the head of the bay. In these mud deposits tracks are made by birds, dogs, crabs, and occasionally fish left stranded. When the tide comes in again, the sediment fills up the tracks left by various adventuring creatures. Thus the process goes on from





Low tide along a shore where the tides are unusually high. When the tide comes in again, it will cover all this area, up to the white beach in the distance, and the boats will again float.

year to year. If ever the crust of the earth shifts and the bed of Fundy Bay becomes dry land, and these mud and clay deposits harden into stone, the imprints left by the feet of birds and dogs will be found there. A track once made in the mud may not wholly disappear, if the mud dries afterward and fresh deposits fill up the old track.

In some places the mouth of a river is so formed that the incoming tide enters as a mighty wall of water, making a great rush that is called a bore. This is especially true at the mouth of the Amazon, and sometimes a high bore comes up the mouth of the Colorado. Fortunately few people live in the region where a bore is known to wash, but there have been times when whole towns were destroyed by what is called a stolen tide, a bore of unusual height. This happened once off the coast of England, and Jean Ingelow told the story in a poem, "The High Tide on the Coast of Lincolnshire." It has happened in other parts of the world also, in Portugal, in Texas, at the mouth of the Indus in India, and in the Tsien-tang River of China. In Frederick Sound in Alaska there is one inlet in which the incoming

tide appears with such a wild rush that no one has ever ventured to explore the channel.

Some people call an inrush of this kind a tidal wave. But a so-called tidal wave is something very different, having no relation to tides. It results from a great storm or a sudden disturbance of the sea bottom due to an earthquake. Whenever a tidal wave strikes a shore, it does great damage. Tidal waves have frequently occurred off the coast of Japan. At the time of the earthquake of 1923 there was a large rush of water in Sagami Bay that partly overwhelmed the cities of Odawara and Kamakura. Not so very many years ago our own city of Galveston, Texas, was much damaged by a great wave due to a terrific storm in the Gulf of Mexico. Most of the houses of Lisbon, Portugal, were thrown down by an earthquake in 1755, and at the same time a tidal wave rolled in from the Atlantic and drowned hundreds of people.

#### OVERFALLS

There is something besides its high tides that makes the Bay of Fundy interesting. This is an overfall, situated at the edge of the city of St. John, on the St. John River, a stream that in its upper reaches forms part of the boundary between Maine and Canada.

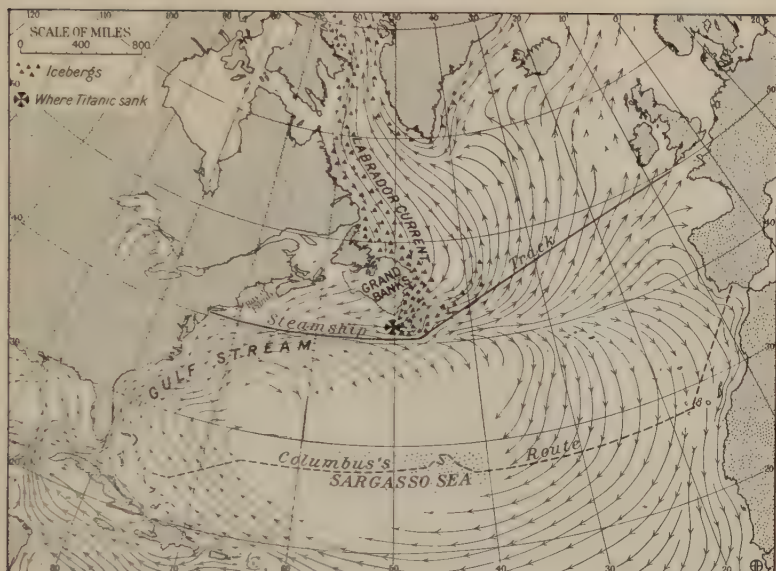
An overfall is a cataract that drops its waters below the tide mark into the sea and is reversed, or turned back, when the tide comes in. The overfall at St. John is remarkable because it is near the Bay of Fundy, where the tides are higher than anywhere else in the world. When this inrush of tidewater rises higher than the falls, it pours over them and into the stream above with a great wash, forming a swift rapid.

Another overfall is found in the southeastern part of Alaska on the island of Revilla-Gigedo, which got its name from an early Spanish explorer. Down through this island

flows the beautiful river Naha, having four lakes in its course, the uppermost one of them, Lake Jordan, being named for the senior author of this book, because it was at the Naha that he once studied the run of the salmon. At the mouth of this river is a curious waterfall wedged in among the rocks. Outside in the channel the tides run high, and when they come into the mouth of the river, they rise higher than the waterfall. Then over the rocks there flows a great current of salt water, forming an overfall like the one on the St. John. It is one of the most remarkable natural curiosities of northwestern America, but not very many people see it, because the island of Revilla-Gigedo is not often visited by tourists.



The overfall, or reversible falls, on the St. John River, New Brunswick. The river has a drop of from seventeen to twenty-five feet in a narrow gorge, and when the tide is low there are strong rapids flowing down to the sea; but when the tide turns and flows up the river, it rises so high that the water actually runs in rapids up the river. The photograph shows it nearly at mid-tide, when vessels can safely pass through the falls.



Map of the North Atlantic Ocean region. Note the location of the ocean currents, the Sargasso Sea, and the Grand Banks.

## II. OCEAN CURRENTS

Besides the waves and tides, there are other movements of the ocean called currents, which are wide streams of water flowing slowly through the sea.

The best known of the ocean currents flows along the northern coast of South America and through the Gulf of Mexico. It swings around the Florida peninsula and off the eastern coast of the United States, a stream of deep blue water. Then this Gulf Stream turns eastward, and crosses the sea, making the west coast of Ireland and Scotland relatively warm in winter and very wet, a good deal warmer and a good deal more cloudy, for example, than the east coast of Scotland. On up to the north it goes, almost to the Arctic Ocean.

Another ocean current, called the Labrador Current, comes



down from the polar regions, west of Greenland and down along the coast of Canada and the northeastern part of the United States.

In the warm waters of the Atlantic grows a seaweed, the most highly developed of the marine vegetation and the most like an ordinary plant. It has no roots, but has what seem to be leaves, and small floats which look like berries. This seaweed is called sargassum, and near the equator, where the current of the water is very slow, the sea is full of this little plant. Attached to nothing, it grows freely to a length of two or three feet, and as the water does not flow rapidly enough to disturb it, the plant is developed in enormous quantities. The part of the Atlantic Ocean that is covered by sargassum is called the Sargasso Sea.

The Sargasso Sea lies on the direct route between Spain and the West Indies, and on his first voyage of discovery Columbus and his men were forced to cross it. They supposed that the roots of the plant were deep in the ocean bed, and that they would surely become entangled in it and perish. The men of the crew were terrified. They begged Columbus to turn back, and some of them were so wild with fear that they threatened to throw him overboard if he sailed into the dreaded tangle. When you read Washington Irving's life of Christopher Columbus, you will find out what excitement there was aboard his vessels because of that threatening-looking seaweed.

In the Pacific Ocean the Japan Current comes up from the region east of the Philippines, passes Formosa, and runs close to the shores of Japan, where it is called Kuro Shiwo, which means the Black Current. It makes the summer in Japan very warm and moist. From Japan, this current continues in a northeasterly direction until it approaches the Aleutian Islands. A continuation of the main current, flowing off the coast of Alaska and British Columbia, gives this

region a mild climate. The stream then moves southward along our Pacific coast. When the current passes Point Conception to the west of Santa Barbara, its flow spreads outward into the open sea. By the time it reaches the end of lower Mexico practically all the waters of the stream have turned to the west. They flow gradually back across the Pacific to the Philippines and thus complete the grand circle.

From the East Indies there comes a current which sets eastward through the multitude of islands that fill the South Seas. Passing Samoa and Tahiti, it goes to the Marquesas Islands and almost reaches the continent of South America. Here it turns northward and swerves to the west again past Hawaii and loses itself in the Pacific.

A very interesting thing about these currents is that they carry certain creatures from one island to another. A beetle or a lizard on a floating log may be taken a long way by the current. Sometimes little fishes are borne along by the current and in that way they are passed from one island to another. Around each island there is a narrow belt of water, or "sphere of influence," inhabited by young fishes that were hatched near the shore. When full-grown, shore fish rarely go into deep water; some of them would drown if they got beyond their depth. But sometimes the young fishes get into the current and drift with it to new waters.

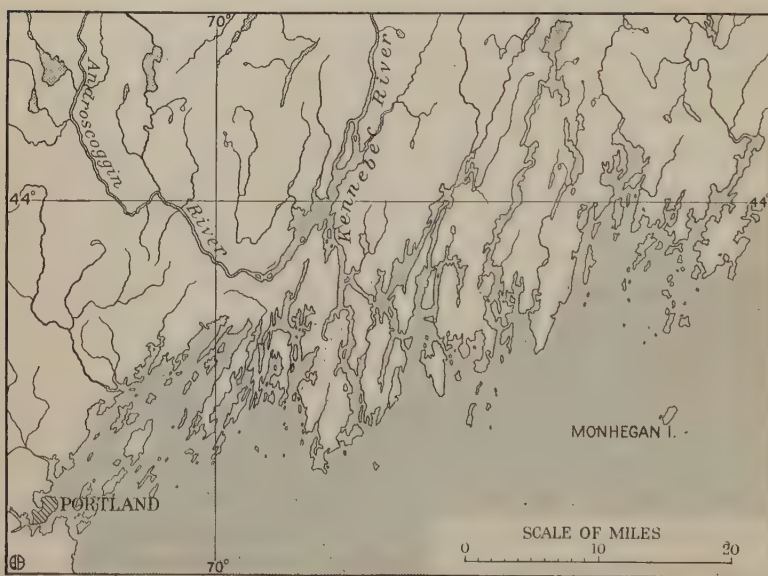
### III. CHANGING COAST LINES

#### HOW THE COAST LINE CHANGES

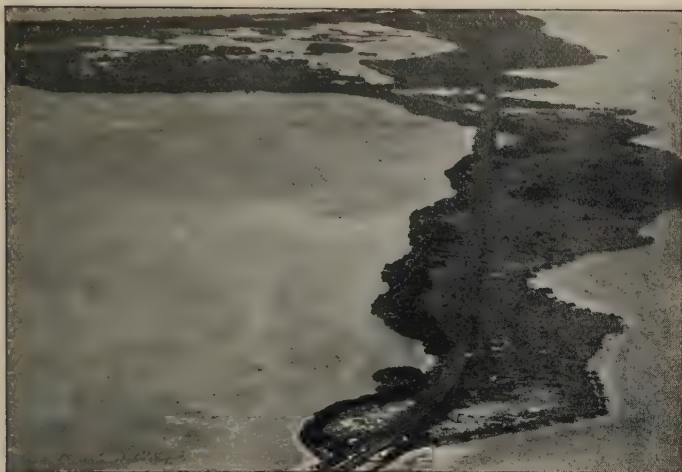
The ocean, because of its eternal motion, is always busy with its shores. It tears at the land, beats down the cliffs, and gradually carries them away. But like Robin Hood, the gay adventurer of Sherwood Forest, who took from the rich that he might aid the poor, the sea gives to one place what it takes from another. Although it destroys cliffs, it carries the rock — ground up into sand — to some other

locality, and there it builds a silvery looking beach or a sand bar. Out of everything nature pulls down, she makes something else. She never really destroys anything, although she is forever changing the surface of the earth.

Because the ocean is building up as well as tearing down, the shore line of every continent is slowly changing. It has been changing ever since the land rose from the sea, and will continue to change as long as it lasts. Bars are being piled up against the mouths of rivers, forming lakes where once were estuaries or river mouths. After the passing of years — sometimes not so very many, sometimes several centuries — some of these lakes become filled up with sand that the streams themselves have carried down, and by and by they are transformed into dry land.



Map of a small section of the Maine coast near Portland. This coast line was formed by the sinking of the land in a region where there was a series of valleys and high hills near the coast. The sea has run up the old valleys and has made islands of some of the former hills.



Airplane view of a portion of the Florida Keys, showing an enclosed lagoon. Dead coral reefs underlie the shallow waters surrounding the land areas. The living reefs are from three to fifteen miles outside.

It is not only the gnawing and building of the ocean and the work of rivers that change shore lines. In some regions the surface of the earth is rising, while in others it is sinking. One way in which we know it is sinking is that geologists have found the channels of rivers, like the Susquehanna, the Delaware, the Hudson, and the various drowned streams of the West, extending under the waters of the sea far beyond the place where the streams themselves disappear. All in all, this story of changing coast lines is a very interesting one.

#### THE FLORIDA KEYS

Perhaps the most striking example of the building up of a coast by the sea is along the shore of Florida. Florida is by far the youngest section of our country and the greater part of it was built up from the sea. Around its southern shore is a group of islands made of light white rock. These are known as keys, the largest one being Key West, which was called Cayo Hueso, or Bone Quay, by the Spaniards.



Outside these keys, in the shallow part of the sea, live the little animals called coral polyps, which grow up like flowers, with spreading tentacles at the top that look like petals. As these little creatures die, their hard skeletons form coral masses of various form and size, many thousands of polyps being required to make a few feet of coral. When the coral masses are torn loose by the waves, they are piled one on top of the other, like scrap iron. The action of the water upon the slowly dissolving lime of the coral skeletons cements them together, until, as many years pass, the coral masses are welded into reefs.

The storms that often strike the Florida coast break off many of the coral formations, and these are repiled in heaps. To these heaps additions are constantly made, so that finally the reefs rise almost to the surface of the water.

Then the seeds of the mangrove, drifting about, lodge on the reefs. In all the shallow waters of the tropics, mangroves are likely to be found. They are curious trees or shrubs that look like an alder but have horizontal branches which send shoots straight down, making a tangle which catches seaweeds, coral, sand, and drift of all sorts. The mangrove pod has a long, slender point at the lower end; and when the pod falls, it shoots straight into the water, strikes bottom, and grows there, starting another tangle of mangroves. Sometimes the waters and the winds bring bits of other plants and seeds which take root on the reef, and by and by it becomes an island with vegetation. Thus, islands are forming along the Florida coast.

Key West is one of a series of coral islands which have been raised well above the water and in places have been broken by the stormy waves, thus forming a string of little keys outside an old reef. Outside of this will arise another line of coral reefs on the shallow bottom, for corals grow where the water is not deep, and they die as soon as fresh water touches them. On the outer reef, the coral masses do not at first reach the



Key West, Florida, as seen from an airplane. The island on which the city stands is only about four miles long, and was built up from material piled on a dead coral reef by the wind and waves.

surface, but they serve as a place for the accumulation of materials until the mangroves take possession, and after that the development into islands progresses steadily. Then some change of level, some shifting of the sea bottom, may raise them right out of the water, as Key West has been raised. Florida is the only place in our country where the shore is being built up by coral polyps. The outer edge of the peninsula is made up of a series of old dead reefs, the oldest reefs being the inside ones.

Mangroves grow in the South Seas also, and there is a little fish about six inches long, called skippy, which climbs up in the bushes and runs among the branches hunting for insects. Though it is a fish, the skippy is as spry as a lizard. The senior author once knew a pointer dog in Pago Pago, Samoa, who used to spend much of his time watching these skippies in a mangrove close to the shore. At intervals he

would point and bark at them, as hunting dogs have a way of doing when they sight game. Perhaps he thought they were some curious kind of bird.

#### THE MASSACHUSETTS COAST LINE

Jutting eastward from the coast of Massachusetts in a sweeping curve is the long sandy projection of Cape Cod. Many centuries ago it was very different in appearance from what it is today. The narrow arm reaching northward was much wider, and the main part of the projection was narrower. The waves tore down the eastern or ocean side, trimming off the arm that curves northward and making it very narrow. And the waves threw back this material and deposited it, together with sand carried there by ocean currents, on the land just west of the point, extending it farther out into the water.

There are numerous swamps and small lakes on Cape Cod. These are very interesting, because most of them were once bays open to the sea. The waves piled sand across the mouths of these bays, inclosing them and forming shallow lakes.

Cape Cod used to be very much dreaded by seamen, because during the heavy fogs that hang over the Massachusetts shore, vessels traveling up or down the coast were often wrecked on the jutting sand bars. Early in its history, the people there recognized the need of a direct waterway connecting Buzzards Bay and Cape Cod Bay, both on account of the danger to ships in rounding the point, and because of the time and distance such a passage would save. As years passed, several attempts were made to cut a canal between the bays, but because of lack of funds the project had to be abandoned. Finally in 1909 a company was formed to build the canal, and this time the money was obtained to push the work through to completion. Now an artificial waterway thirteen miles long connects Buzzards Bay and Cape Cod

Bay, a canal broad and deep enough to permit the passage of large ships. It is no longer necessary for vessels to sail around the narrow eastern arm of the promontory.

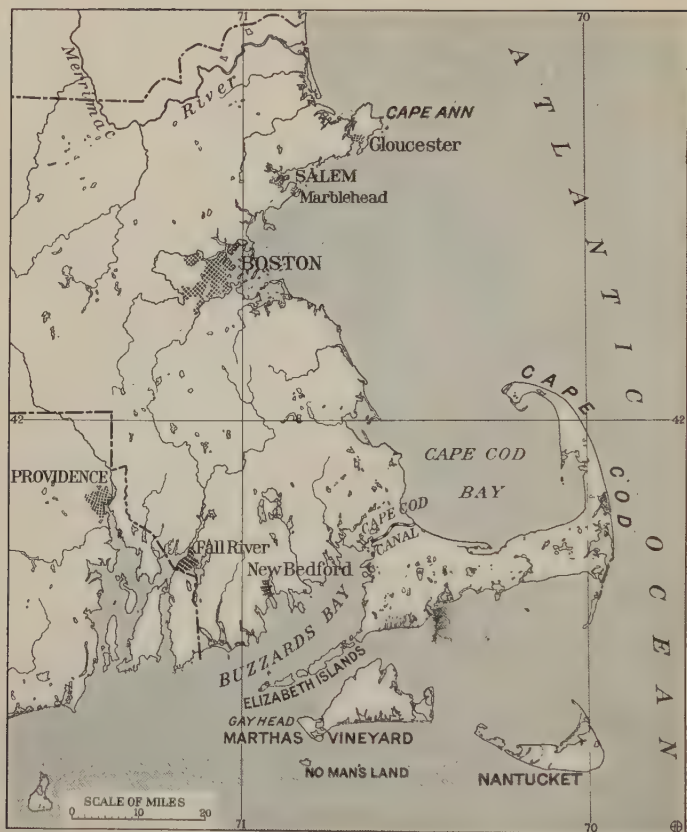
Cape Cod has its name from the schools of codfish which used to breed there. Far back in the beginning of the seventeenth century, this cape was discovered by a bold English navigator, Captain Bartholomew Gosnold, and because of the abundance of cod in the waters around it, he christened it by the name it still bears.

South of Cape Cod are the islands of Nantucket and Marthas Vineyard. Once both of these were an extension of the mainland, but the wash of the waves has separated them, making islands.

The Indians said Nantucket and Marthas Vineyard were created by a giant named Maushope, who used to haunt this region, and who formed them because he wanted a place to rest when he strode over from the mainland. First he made Nantucket by throwing ashes from his pipe into the sea, piling them higher and higher until they rose above the water. Nantucket is shaped like a crescent, and on its northern side are several half-inclosed bays, the fringe that helps to shut them from the ocean having first been torn from the island by the waves and then piled back against it, gradually forming a sort of wall. Some day these bays will be wholly inclosed and they will then be lakes, like some of those on Cape Cod that were formerly harbors open to the sea.

Marthas Vineyard was discovered by Captain Gosnold soon after he sighted Cape Cod, and was named, so old chronicles say, for his little daughter in far-away England; and the wild grapes which trailed in leafy ropes along its knolls led him to call it a vineyard. Many sparkling ponds lie along the southern side of this island, ponds that, like those of Cape Cod and Nantucket, were once shallow bays cutting into the coast.





Map of the Massachusetts coast line, showing capes and islands. Notice that the Cape Cod Canal saves many miles of travel for ships going from New York to Boston and ports farther north.

At the west end of Marthas Vineyard is a rocky promontory of such variegated and beautiful coloring that Captain Gosnold called it Gay Head. It contains a number of red, cup-shaped depressions that have erroneously been called craters.

The Indians had a legend about Gay Head and its cup-shaped depressions. Sometimes — so the tale goes — when the giant Maushope was hungry, he pulled up great trees by

the roots, kindled a fire, and broiled a whale on the coals, and these red depressions are the places where he did his cooking. The forest people also said that one day when he wanted a resting place from which he might bathe his feet in the sea, he broke off from Gay Head the island which we call No Man's Land and let the water in between.

Maushope was so fond of smoking that he never stopped except when he was eating or sleeping, and because he could not always get tobacco for his pipe, he sometimes had to use pokeweed, which makes fumes as thick as fog. So the tribes of that region came to believe that the heavy fogs that so often hang over the Cape Cod and Marthas Vineyard region came from the pipe of the Indian giant. This amused the white settlers so much that they often joked about it. To this day, when fishermen on the islands see the fog lowering in thick black whorls, they say, "Here comes Maushope's smoke."

According to another tradition of the Red Men, Maushope must have had all the awful traits of wicked giants in fairy tales, for one day he fell into such a rage that he pitched his wife into the sea. She lies there still, south of Newport, and the rock she has become is called Sekonnet Point. He threw his children into the ocean also. They turned to fishes, and that is why there are so many herring, cod, and mackerel running in the waters washing these islands and Cape Cod.

Off the northern coast of Massachusetts there is a rocky headland that is slowly but surely changing. This is Cape Ann. Because it is composed largely of granite, the waters gnaw there very slowly, and it will be a long, long time before they can greatly alter its outline, although each year they tear it down a very little. Cape Ann is a point much dreaded by sailors, and near it is a reef called Norman's Woe, which has been a place of disaster to many a good vessel.



Map of the Puget Sound region, showing how the sea long ago filled an extensive inland valley, making islands of the former hills.

#### SANDY HOOK; CAPES AND SOUNDS OF THE ATLANTIC COAST

Sands brought down by rivers and borne along the coast by waves and currents have made Sandy Hook, a narrow sandy peninsula about six miles long, which projects into the Lower Bay of New York.

In the same way were formed Cape Hatteras, Cape Look-out, and Cape Fear on the North Carolina coast, long, low points dangerous to shipping. In fact, not only Cape Fear

but the whole of its island has been formed by sands carried down by the Cape Fear River and thrown back by the sea.

Thus, too, have been formed the Atlantic coast sounds. Long, narrow sand bars and spits have been built up, inclosing bodies of water that look like lakes but are really arms of the ocean, as you can see from the map on page 141. The largest are Albemarle Sound and Pamlico Sound, and there are various others about which we have already told you in Chapter Six.

#### PUGET SOUND

All things considered, the finest harbor in the United States is on the coast of the state of Washington, the great indentation with its many branches that is known as Puget Sound. Puget Sound was greatly deepened by the ice. Indeed, Commencement Bay in the upper part of the sound was carved so deeply by the glaciers from Mount Rainier that an anchor will not reach the bottom.

There are numerous islands within this sound, all of which were once high hills. During the Glacial Period these were worn down and polished by the ice, and now the waves are gnawing at them, tearing them down and then piling the rock material against them again, changing their outline gradually, though very slowly.

So you see that the shore line of America is forever being changed, by the waves tearing down and piling up sand and rock again, by the shifting of the ocean bed, or by both of these combined. Geological changes occur so gradually that it requires many hundreds of years before they can be noticed; but steadily, slowly they are taking place, and if one could live for several thousand or million years, one could tell very strange stories about what has really happened along our country's coast.



## CHAPTER TEN

### NATURE'S TREASURE CHEST: A STORY OF MINERALS

#### I. SOME USEFUL MINERALS

##### IRON

IN the eastern part of Missouri, about seventy miles south of the city of St. Louis, there are two elevations known as Pilot Knob and Iron Mountain, not mountains at all, but just low hills. They are of great interest to the scientist because they are composed almost entirely of iron ore.

Ore is a rock containing any metal worth taking out of the ground. A metal is a chemical element that, when separated from the rest of the ore of which it is a part, is of use to man for manufacturing purposes, or will provide him with implements and articles he needs and will help to make his life more comfortable.

Iron is a metal, the most widely distributed of all, which is a fortunate thing for mankind because it is the most useful. Without it, we should lack many of the conveniences of present-day life, for iron makes it possible for us to have steel-frame buildings, steamships, bridges across rivers, and the tools and factory wheels by means of which countless useful things are fashioned.

Some beds of iron ore lie very deep. Others are so near the surface that the ore may be dug out of open pits. There are several forms of iron ore. Some are hard and black and must be broken or blasted out from the rocks with which the ore is found; some are a loose yellowish or reddish brown earth that can be scooped out with steam shovels.

The reddish brown oxide of iron is called hematite, and

this is what gives the red tinge to rocks and soil in regions where iron occurs. Hematite abounds in the Lake Superior region; the Mesabi Range, on the west side of this lake, is almost entirely made up of hematite. Scattered over Missouri, Pennsylvania, West Virginia, New York, Michigan, Wisconsin, and many other states are large deposits of hematite.

When picnicking in the hills and woods, you may have noticed the yellowish hue of many a cliff and stream. This is often due to limonite, a yellow iron ore. Limonite is a loose earthy material, which sometimes occurs in huge deposits, especially in old bogs. It is mined in Virginia, Tennessee, and Alabama, and is found in almost every part of our country. In fact, there is hardly any part of the United States where iron in some of its forms does not abound, although the deposits may not be large enough for mining.

Another form of iron, known as iron pyrites, a compound of iron with sulphur, is not very valuable as a mineral. But it is of such a glittering yellow color that many people have mistaken it for gold, and so it is called fool's gold. It is harder than real gold and also brittle, which gold is not. Furthermore, it has crystals with flat faces; gold does not usually occur in crystals.

#### COPPER

In the colonial times when boys and girls had a great many tasks to perform, the little Pilgrim maids spent their Saturday mornings, and afternoons too, in scouring copper kettles, plates, and dippers. Every thrifty housewife prided herself on possessing some of these articles, so you may know that copper was a metal very much in demand then for such purposes.

As years passed and men came to know more about the use of metals, the copper kettles, plates, and dippers gave way to utensils made of other materials; copper was needed



A Utah copper mine. This is one of the largest copper mines in the world. Mining operations are carried on in the hills, and the miners live in the settlement in the valley.

for other things, and therefore was too valuable to be used in this way. After the discovery of electricity, and the use of electricity to supply the needs of man, a great deal of copper was required to make the wire necessary in electrical work, as well as for other purposes. So men began seeking this metal more eagerly than it was ever sought in colonial times. They found it in vast deposits among the volcanic rocks of the Keweenaw Peninsula on the southern side of Lake Superior, where there are some of the richest copper fields in the world. Here this valuable mineral occurs mostly in a pure state; but elsewhere than in the Lake Superior re-

gion it is usually in composition, as geologists say, which means that it is combined with sulphur or other substances.

It is believed that the copper deposits of the Lake Superior region were known to the prehistoric people of the Mississippi and Ohio valleys. When the white men began digging there, they came upon pits that had been closed over, perhaps for thousands of years, in which were lumps of ore that had been chipped by crude tools. How the ancient diggers dislodged them from the rock and earth that held them is a mystery to modern engineers. But there they were, and evidently they had been left where the miners of today found them because the prehistoric workmen knew no means of getting them to any other place.

#### SALT

Salt is a mineral that goes into most of our foods and helps to make them palatable and wholesome, if there is not too much of it. Consequently it takes millions of tons each year to supply the world's needs. But there is always enough, because it is to be had from many places all over the world. Huge masses of salt are still untouched in beds which were once arms of the sea.

In ancient times people used to get salt from the ocean, and as a belief in fairy tales was very common then, a story arose that far down among the sea caves a magical mill was forever grinding away, turning out tons and tons of salt throughout the day and night. But the salt in the ocean was first in the crust of the earth, and salt is still diffused everywhere through the rocks. The sea is salty because its waters have absorbed much of this mineral as they have washed the shores, and because the rivers pouring into the sea have picked up a great deal of salt in the course of their wanderings.

Deposits of salt are found in many parts of our country, in dried-up bays buried long ago, as in Michigan and New York.



Wherever we find salt beds, we know that they mark the sites of ancient bays, which became separated from the sea and finally were dried up, or the site of bodies of water like Great Salt Lake, which have no outlet.

When layers of rock and earth have covered the dried-up arms of ancient seas, the salt must be obtained either by forcing water down upon it so that the salt is dissolved and pumped out, or by opening a shaft to the beds and digging the salt as miners often dig iron ore. But occasionally it happens that nature takes a hand in the matter of getting salt to the surface, making it unnecessary for men to bore underground for it. Water seeps down into the earth near the salt deposits and then is forced out again as salt springs. The water from these springs is collected and evaporated, and the dry salt is left in the vats. This salt is cleaned, or refined, and sent to market.



A steam shovel getting out salt in a large salt mine in Louisiana.

In early colonial days salt springs were discovered near Syracuse, New York. In fact, that city owes its beginning to salt springs, and salt used to be the chief source of its wealth, for when the springs proved that there were rich deposits of the mineral underground, people began boring down to these deposits. The mining and preparation of salt for the market was long an important industry of various parts of western New York.

#### CLAY

Throughout the eastern part of the United States, and in some other sections of our country, are found beds of clay. Clay is made up of fine substances formed largely by the decomposition, or decay, of feldspar or other rock minerals. The ancient glaciers helped to make clay by grinding up rock masses as during the ice ages they swept down from the north. The frosts helped too, wedging the rocks apart, and the rains tore them down; and through various other causes, slowly but steadily with the passing of the ages, rocks have become broken and decayed.

Often the broken and decayed rock bits have been washed down into lakes or into the ocean and deposited there as sediment. These deposits have been made also along river beds. Thus it happens that clay frequently occurs along the banks of streams and on the shores of lakes and seas.

Out of clay a great many different things are made. When pressed into small rectangular blocks and "fired" — that is, burned in a kiln, or large oven — it becomes brick. Pottery is made from clay that has been molded into the desired shape and then heated or "burned"; and so is tile, such as is used in roofing houses, facing fireplaces, and making tiled floors. Because there are many different kinds of clay, many varieties of articles can be manufactured out of this very valuable substance.

Common clay, such as is used in the manufacture of ordinary brick, contains some iron. This iron gives the brick its red color, for it causes the clay to turn red in burning. The less iron the clay contains, the lighter in color it is. Potter's clay, the kind used in making the better varieties of pottery, has very little iron. Porcelain clay, or kaolin, contains almost no iron, and consequently it is white. From kaolin many varieties of pottery are made, including the most beautiful china.

From deposits containing clay and lime, we make cement and concrete, a material of constantly increasing use in our country in road building as well as in the structure of houses and office buildings. Concrete, reinforced by iron rods passing through it, resists earthquakes and is also fireproof.

It is interesting to think that many of our residences and business buildings, as well as the vases and dishes used in our homes, have been made from clay. Because so much brick, tile, and pottery is needed to supply the wants of the people, the manufacture of these products has come to be one of America's great industries.

## II. PRECIOUS METALS AND STONES

### GOLD

In the great book of stories called the *Arabian Nights* we read that long ago in Persia there was a robber chief named Cogia Houssain, who stored his plunder in a cave in a forest. One day Ali Baba, a poor woodcutter, learned the magic word that opened the door of this cave and went in, and found treasure such as he never had dreamed of. There was gold and silver in heaps, and jewels in bags and boxes — such stores of priceless things that many men with their donkeys could not carry them away.

Everything in the cave of the Arabian story — except the pearls, which were taken out of the shells of oysters — came



Mining gold in Alaska by the hydraulic or placer method. The water washes away the lighter materials and leaves the heavier particles of gold behind.

from the crust of this old earth, just as copper and iron come from it. The gold was stored in quartz veins that were made during the intense heat engendered in the days when mountains were formed. Then, as the mountains were slowly broken and worn down through the action of frosts, rains, and other forces that are forever tearing away at the rocks, the gold in the broken portions of the crust was washed into the streams. Being heavier than other metals, it dragged along at the bottom, and there it lay until somebody was fortunate enough to come along and find it.

Sometimes, in places where streams have cut through the mountains, the gold from the rock sinks into depressions or pockets along the river beds, and now and then we find gold scattered in the soil of valley floors. Occasionally lumps called nuggets are discovered, but usually gold is found in minute particles and is pure, for it is seldom combined with



other elements. But no matter where it is now found, it was originally deposited deep within the heart of a mountain range.

Most metals rust, or unite with oxygen, on being exposed to the air, but gold always remains bright. This is the main reason why it is so highly prized. Jewelry and vessels made of this gleaming yellow stuff never lose their luster, so the king with the golden crown or the lady with the golden necklace does not need to worry about having it polished and bright. It needs only to be kept clean.

Sometimes gold is obtained by panning. The miners place in a pan some of the gravel from a stream bed and rock it back and forth so as to separate the precious metal from the gravel. This method was used by the men who rushed to California in 1849; and in the songs and stories of bonanza days, which were the days of California's gold rush, many a mention is made of "panning gold." These treasure-seeking pioneers dug up and down the stream beds, loosening the gravel and washing it in pans, in the hope of obtaining some of the precious metal. Taking out gold by means of panning or through the wash of water in other ways, is known as placer mining.

Not all the gold in the earth's crust has been washed down into the streams, because there are many parts of the world in which the crust is unworn. A great deal of gold is still tucked away in quartz veins which extend far down under the ground, and in order to get this gold it is necessary to dig down to it. Scattered throughout the western part of the United States are many gold mines, where shafts are sunk and the gold ore is removed by underground mining from the quartz veins containing the precious metal.

When gold is mined by taking it from quartz, the rock is finely crushed to separate the gold from the other minerals. The gold is then recovered by the use of mercury, a liquid metal in which gold readily dissolves. In some cases it is

necessary to recover the gold by using a solution of cyanide of potassium, in which gold is readily soluble.

We think of our western mountain country as being the land of gold. In fact, the rapid development of the West was due largely to the discovery that gold was hidden away in the mountains. People flocked to the western states in the hope of getting rich. Mining became the great industry of that region, and towns and cities grew up in the mining sections because a market center was needed where miners could bring their gold and silver and obtain clothing and supplies. Thus Denver, the capital of Colorado, grew from a small settlement into a busy metropolis. Butte, Montana, became a bustling mining center, and because of the mines scattered throughout the Rocky Mountain region numerous other towns came to be.

Gold is mined extensively in Alabama; but nowhere else in the United States does it abound in such quantities as in California, Colorado, and South Dakota. Much gold is obtained also from Mexico, as well as from western Canada and Alaska.

Much romance centers around the story of gold seeking. Even before the dawn of civilization men coveted this shining metal because they thought it beautiful and wished to use it in adorning themselves. So it came to be the measure of value. To possess it was to be rich, and in every generation people have flocked to regions where gold was reported to have been discovered. It was once believed there must be a way of making gold by mixing other substances, and many a man spent his life experimenting in an effort to discover the process. But nobody ever succeeded. Yet it was a good thing for the world that they tried to make the gold in this way, for the work of the alchemists, as these seekers were called, helped to open the way to modern chemistry.

During the period of history that we call the Middle Ages, a story went over Europe that somewhere in the world was



In the silver-mining region of southwestern Colorado. The mining town of Silverton is situated in the distant valley at the base of Silver Mountain.

a philosopher's stone, a substance that would touch metals like iron and copper and change them into gold. Many an impostor arose who claimed to have this coveted stone in his possession, and more than one king gave a fortune to somebody who offered to sell it to him. But nobody ever obtained the philosopher's stone. Gradually the world came to know that the only way to get gold is to dig for it, either as the miner digs, or by working hard enough in some other field of activity to earn a big reward.

#### SILVER

In the same quartz vein in which gold is found, silver is sometimes hidden, alloyed with gold. It occurs also associated with lead, zinc, and copper ores. Silver is obtained

in large quantities throughout the western mountain region of the United States, the best mines being in Nevada, Colorado, Utah, Idaho, and Montana.

Like gold, silver is very much prized because it is both beautiful and useful. But it is more plentiful than gold, not so handsome, and much more easily tarnished. Therefore it is not so costly; but it is precious enough, so that throughout the ages men have incurred great risks to obtain it.

The richest of all silver mines are those of Mexico, from which more than one third of the total output of the world's silver has been obtained. The Aztecs knew this precious metal, and their chiefs and their places of worship were richly adorned with ornaments made of silver. When Cortez and the Spaniards who conquered Mexico first visited the country, their eyes were dazzled by the treasure of the natives, and they sent glowing stories back to Spain of the wealth of the region, stories that fired the souls of adventurers with a desire to obtain some of it. The result was that men from the Old World flocked to the New World, bent on securing riches from the mines. By the middle of the sixteenth century a regular trade in silver was established between Mexico and Spain. The treasure ships did not always reach Spain, however. After it once became known that many a cargo consisted of shining metal from the mines of Mexico, piracy on the Atlantic came to be an alarming thing. Galleons bearing silver were attacked, their crews murdered, and their treasure chests carried off by robber crews. In fact, almost the entire story of piracy during the sixteenth century centers around silver from the country of the Aztecs.

#### PRECIOUS STONES

The rocks and sands of America do not hold such variety of precious stones as do those of some lands, but we have a





Rubellite (red tourmaline) from San Diego County, California. The rubellite crystals are the darker, pipe-shaped objects at the right. The large six-sided crystal in the center is quartz.

wide range of stones that are regarded as valuable. In North Carolina and Montana, and in some other regions, there is a very hard mineral known as corundum, which when pulverized is called emery, a substance much used for polishing steel. In corundum small crystals sometimes occur. If perfect, these have a very high value. The sapphire and the oriental ruby are crystalline corundum.

A mineral that is precious if it is transparent is tourmaline, which is found in Maine, California, and other

states. A perfect crystal is often of the most exquisite pink or green color.

Garnets, the richly colored gems our grandmothers loved, are scattered through metamorphic rocks — that is, those rocks that have been altered by great pressure, by chemical action, or by heat. Usually these stones are small, but now and then some are discovered that are two inches or more in diameter. The large ones are almost never clear, and except when perfectly clear and of a dark wine color, the garnet is not very valuable.

A great many precious stones are found in the desert region of the West, in New Mexico, Arizona, Colorado, Utah, and California. A very beautiful stone called kunzite, almost as brilliant as a diamond, and white or a delicate lilac color, is frequently obtained near San Diego, California.

### III. COAL AND OIL

#### THE COAL BEDS

In the Carboniferous Age, millions of years ago, the northern part of North America was very much warmer than it is now and probably the rainfall was much more plentiful. Over vast tracts the trees were as thickly crowded as they now are in the deepest wildernesses along the Congo or the Amazon. The Carboniferous swamps were filled with enormously large flowerless plants, many of them like the horsetail and the club moss of our time but immensely greater. Instead of being a few inches or two or three feet high, they grew into huge trees. For a great many years this growth continued, and then the low swamp area sank beneath the sea. Sand, clay, and gravel spread over them like a thick carpet, and the entire mass became packed and hardened.

After centuries the sea bottom rose once more, and again a dense swamp growth spread over the land. Again the



How a forest in the Carboniferous Age probably appeared. The painting was made by a scientist who had studied the fossil plants of this age.

low areas sank, and the ocean covered them with clay and sand. This rising and sinking and this plant growth went on for ages and ages, until there were many layers packed one above the other.

When the forest growths sank under the sea and were packed down, the clay kept the plants from decaying, because it prevented air from reaching them. They formed a woody substance very much like peat. This woody substance was sometimes very thick, but under the weight of the sand and clay it was packed down tightly. As time passed and the pressure from above increased with the accumulation of deposits of sand, clay, and gravel, finally the whole mass was changed into coal. So these mighty forests of the Carboniferous Age, solidified under pressure, have made excellent fuel.

Three kinds of coal are common — anthracite, bituminous,

and lignite. Anthracite, known as hard coal, is found in sections where the rocks are much folded, especially along the base of the ancient Allegheny Mountains in Pennsylvania. In such places, pressure, folding, and heating have produced a compact mass of coal, and have driven off most of the tar and gas that was in this buried mass. Anthracite coal is harder and freer from clay than bituminous or soft coal, which is the normal, unchanged coal from which gases and tar have not been driven. It gives a more intense heat than bituminous coal and burns with less smoke. Pittsburgh, in the bituminous region of Pennsylvania, is called the Smoky City, because soft coal is burned in its factories. But the cities of Scranton and Wilkes-Barre, where more anthracite or hard coal is used as fuel, are fairly free from smoke.

Lignite is comparatively recent coal, less pure than the ancient coals, being more mixed with clay. It is not nearly so old as the other varieties, and has not been subjected to very great pressure or heat. Lignite is therefore much less valuable than bituminous or anthracite coal.

There was a time when the ancient coal swamps stretched westward from the Appalachian Mountains to beyond the Mississippi. But as the rivers carved out deep valleys, much of the coal was washed out and broken up. Enough remained, however, to make the work of taking it from the ground a mighty industry. Vast stores of coal are hidden among the valleys of Pennsylvania along the slopes of the Alleghenies and the northern spurs of the Blue Ridge Mountains. There are also extensive coal beds in Ohio, Indiana, West Virginia, Kentucky, Illinois, and Missouri. Deposits of a different character, of more recent origin, occur in Colorado, Utah, and Wyoming.

There are large coal fields in Alaska too, and this fact is interesting because it indicates that this region once had a climate almost as warm as the West Indies or the jungles of



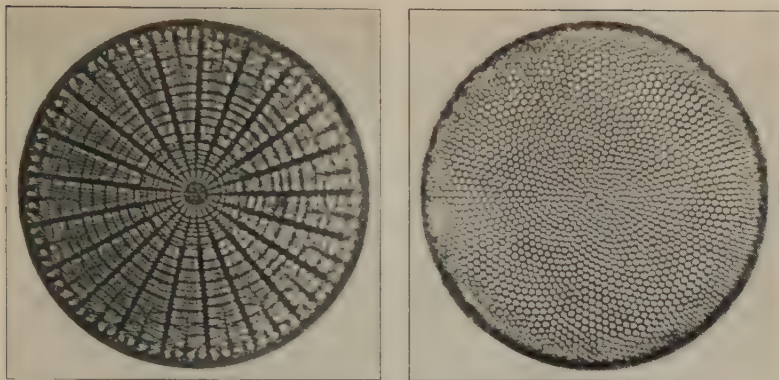
the Amazon. In fact, in some ancient periods heat seems to have spread widely over the earth so that there was little difference in climate.

#### THE ORIGIN OF OIL; THE OIL FIELDS

Some millions of years ago, in the times called the Miocene Period, the coast of California was in the process of making. Vast deposits of sand and clay were being compressed and folded as mountain chains, their new-born peaks and ridges rising like islands among sheltered bays. In those days the northern ocean was filled with millions of little plants called diatoms, each one with a thin, transparent covering of the quartz-like substance that is known as silica. These diatoms had the form of flat disks, though sometimes



A coal mine in the Allegheny Mountains, West Virginia. Here the coal is being mined from a point high up on the mountain side and is carried down to the railroad below by a conveyor belt.



Diatoms from Lompoc, California, as seen through a very powerful microscope.

star-shaped and sometimes long and narrow, and often punctured with little pits like a thimble. They were all far too small to be seen with the naked eye. The steady northwest winds drove them from the colder seas to the shallow bays and sheltered places along the coast. They gathered in greater quantities near the present town of Lompoc, in Santa Barbara County, California, than anywhere else on record. The number of them must have been enormous, for they were piled up solidly to a depth of fourteen hundred feet over a territory two and one half miles long and more than a mile and a half in breadth.

When the land rose from the sea, these deposits of ancient diatoms became rounded, snow-white hills. Some years ago men began to cut into them, taking out bricks of white rock, which are used as packing around hot pipes, because the diatom substance is a non-conductor of heat. It is crushed also and used in filtering, for in sinking to the bottom it carries with it turbid impurities from liquids.

The Lompoc diatom deposits were formed in a little flask-shaped bay on the north side of the Sierra Santa Ynez, one of the picturesque cross chains of the Coast Range. Because of its sheltered position, this bay was chosen as the

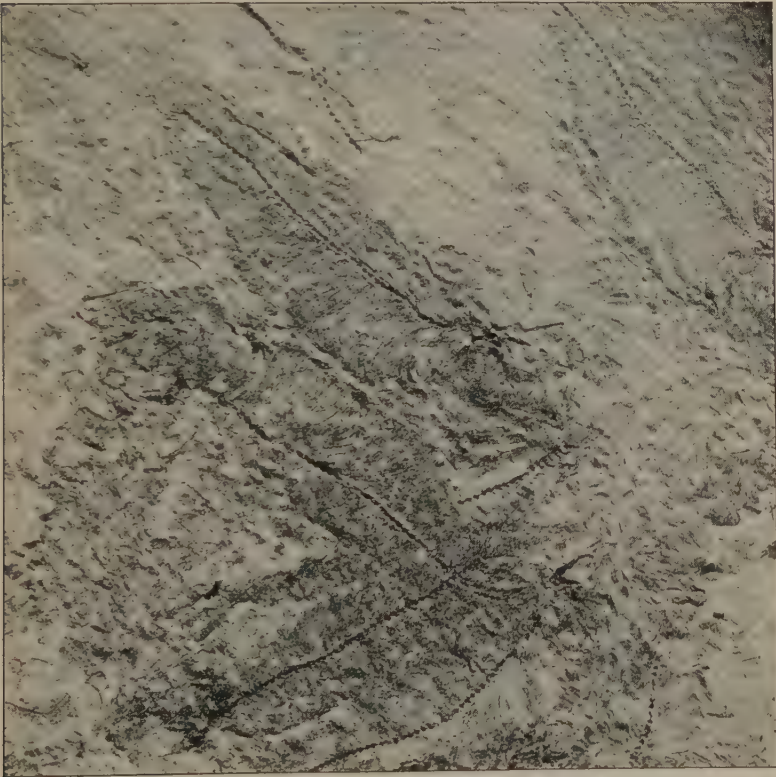


Deposits of diatoms at Lompoc, California. The whole hill is composed of billions upon billions of diatoms that lived here or were swept in from the ocean during Miocene times.

spawning ground of a herring of ancient days which we know by the name of *Xyne grex*. Into this bay at one time came millions and millions of these herring, all of one size, six to eight inches long, covering the bottom of the whole bay, four square miles. And there they all lay down and died, probably through overcrowding. And the diatoms, swarming in this bay in measureless masses, piled up above the herring, crowding down their bones, which in time became part of the diatom deposit.

A few years ago men who were quarrying the diatom rocks dug down through the deposit and took out a good many large slabs of these fossil herrings just as they collected there millions of years ago. They were lying thick together, all flat on their sides. In all this amazing group there was not a single fish of any other kind, although nearer the surface were found bones of several other kinds of fishes and also bones of porpoises, shearwaters, a sea cow, and a fur seal, scattered through the diatoms.

The picture below shows a small section of a slab of diatom rock. The original slab measures twenty by sixteen inches, and has twenty-one of these fishes upon it, besides parts of others. This seems to be a fair average for the whole stratum. It indicates that the total number in the bay at the time of the great catastrophe was about 1,337,195,600—a tremendous school of fishes!



A slab of diatom rock with skeletons of buried fishes, a kind of extinct herring, of the Miocene Period. Diatom rock is very soft and can be cut with a knife. The surface of this slab has been lifted off, leaving exposed to view the bones and outlines of the fishes that were buried millions of years ago.



Three problems remain that will very likely never be solved. Why was the bay crowded with a billion individuals of *Xyne grex* to the exclusion of all other fish? Why did they all die instantly with no sign of agony? How were they tightly sealed so that they did not go to pieces in decay? No one knows, but the probabilities are that so many fishes overheated the water and at the same time consumed its dissolved oxygen, without which no fish can live. Afterward the mass of white diatom plants sealed them up tight.

It is thought that the chief origin of petroleum in California, and elsewhere where it has an asphalt basis, is from diatoms. We know that each little diatom plant secretes a drop of oil, and billions on billions of them might furnish many gallons of crude oil, as we find it in the rocks of the famous oil sections of California. The oil certainly does not come from remains of fishes or of seaweeds, and unless we accept the diatom theory, its origin remains a mystery.

When the diatoms lie near the surface of the earth, oil can escape into the air; but when they are buried under sediment, the oil is stored there until an opening is made down to it. Sometimes in places where a great deal of oil collects under the ground, gas is set free; and occasionally it happens that this accumulated gas forces the oil up with a great spurt, very much as water is forced out of a geyser by the pressure of steam. Such a well is called a gusher or flowing well. Occasionally the output from a gusher is so great and the oil comes from the ground so rapidly that people cannot get it into tanks and barrels quickly enough. Then thousands of gallons of the valuable fluid spread over the ground and are wasted. This has happened a number of times in the oil fields of California. Usually, however, the wells are not flowing ones, and the oil must be pumped out. In the fields of Kern, Ventura, Los Angeles, and Santa Barbara counties, California, thousands of oil pumps work away day and night.



Oil derricks in the Goose Creek oil region, Texas. The derricks are built to support the long drills which are used in boring the wells down to the oil beds.

A good oil well may be as valuable as a gold mine, because oil is one of the products most used today. Crude oil makes excellent fuel. When refined or distilled, it yields asphalt, paraffin, gasoline, benzine, naphtha, kerosene, and lubricating oils.

Many people speak of petroleum as coal oil, but apparently oil has no direct connection with coal, for some of the richest oil fields are in regions where coal does not occur.

Besides the California oil fields, there are very important ones in Texas, Oklahoma, Wyoming, Kansas, Pennsylvania, Ohio, Illinois, and West Virginia. Some rich oil fields have been discovered in Alaska also. In Pennsylvania and elsewhere in the East, the oil is very different from that of Cali-

fornia, having a paraffin basis. The origin of such oils, so far as we know, is still undetermined.

#### IV. HAPPENINGS OF MIOCENE TIMES

The region about Lompoc, including the counties of Los Angeles, Santa Barbara, and Orange, is amazingly rich in remains of early life. One may say that if the soil in Los Angeles County could be removed, the rocks below would reveal an enormous range of information about extinct forms.

We find remains of extinct fishes and other sea animals whenever a brickyard is established here or a pit dug into the ground for any purpose. At La Brea, within the city limits of Los Angeles, is an ancient lake of asphalt containing many animal remains, about which you will hear in the next chapter. At Lomita, near Los Angeles, in a hill made up of sea shells and microscopic chalk animals, we find remains of sharks, sperm whales, sea lions, elephants, and horses buried together. The horses and elephants are nearest the top, and probably were drifted in by a flood on some river. We are sure that they did not naturally associate with whales and sharks. Some of the sharks were the largest ever found. Judging from preserved teeth, one of the sharks may have been a hundred and fifty feet long, almost big enough to swallow a horse or a man. But no man lived in those ancient days.

The Miocene Period was a very short one in geological time, not more than a few million years, less than a hundredth part of the period since the Appalachian Mountains were raised from the sea.

We can get some glimpse at the age of our earth by noting what happened in one single locality in Miocene times. First, the western half of what is now California spread out wide and flat under the sea. Then came the long period when the several chains of the Coast Range were folded, as one might make wrinkles on a tablecloth by pushing the sides together.

The Sierra Santa Ynez being upraised, the rains and the rivulets began to tear it away. A stream flowing down its north side wore out the pocket of Lompoc. Then the whole region was again submerged. Diatoms swarmed in the little flask-shaped bay and the herring came in to spawn. Still later, a horde of fishes, porpoises, and birds appeared to feed on the herrings. Finally the bay was filled with pure diatoms to a depth of fourteen hundred feet. That took a long time, for millions on millions of them could be put into a thimble.

At the end of the Miocene Period, the mountains sank once more and a wash of broken rock and clay swept over, burying the whole diatom mass. With this came in whales, great sharks, and other creatures; and as they live in open water, we know that the Santa Ynez mountains must then have been submerged to a considerable depth. In time, also, clay formed a cement, binding the loose stones together into what we call conglomerate, in which bones and teeth of various sea beasts are mixed.

This change marked the beginning of the next geologic period, the Pliocene. Not very long afterward, mountains rose (for the last time, we hope) and nature as usual went to work to carry them back to the sea. A new stream ate its way through the conglomerate, carrying off most of it, and then cut down into the diatom masses, even to the old rock bottom. Land life came on again, and the slopes were covered with vegetation, especially the straggling dwarf live oak or chaparro, which makes the thickets called chaparral.

All these happenings constitute a short episode — only a few million years — in the patient process of making the world on which we live today.





PART TWO .  
LIFE UPON THE EARTH



*Copyright by William T. Shaw*

A wild Rocky Mountain goat high up on the side of Mount Baker, Washington. Dr. Shaw had great difficulty in climbing to a position from which to photograph this animal without frightening him away.

## CHAPTER ELEVEN

### THE LIFE OF AGES AGO

#### I. CHANGES IN THE FORMS OF LIFE

WHEN the Laurentian V first rose from the water, there was, so far as anyone knows, nothing alive on the land or in the sea, for until the rocks and water had cooled to a temperature below that of the boiling point, life was not possible. Then in the ocean there appeared simple little animals and simple little plants, each consisting of one cell, gathered together in lumpy masses. Whether plants or animals came first is a question nobody can answer. Both sprang from the same source, and in their lower forms the one kind of life can scarcely be distinguished from the other. The fundamental difference is that plants get their food from air and water, and animals feed on other animals or on plants.

The very simplest animals are so tiny that hundreds of them can live in one drop of water, and it is believed that the first living creatures were of this nature. They are not composed of different organs, as are horses, elephants, monkeys, and all the other animal folk that we can see with our eyes or touch with our fingers; but, instead, the body of each is just one cell, with no heart, no stomach, no muscles, no nerves. They are so minute in size that the naked eye cannot see them, but by studying them through the microscope, we find that these creatures have the power of doing in a very simple way all the things that are necessary in the life of an animal. They breathe, take in food, and reproduce themselves.

Although one-celled animals are so tiny, they are formed as perfectly as any of the higher types, though with far less complexity. This is also true of the plants. The diatoms about which you have read are too minute for the eye





A one-celled organism in a drop of water, as seen through a microscope. These tiny beings use food and oxygen and do in a simple way all the things that are necessary for their life.

to see, yet each is as beautiful in structure as the finest flower or most gorgeously adorned bird. If you don't believe it, look at a rose or a peacock and then at the picture on page 249.

But all this does not tell anything about how life began upon the earth. That is a question to which we can give no answer. We simply do not know. About the only thing we do know of the first form of life is that it existed in water.

Millions of years afterwards life appeared on the land in both plant and animal forms.

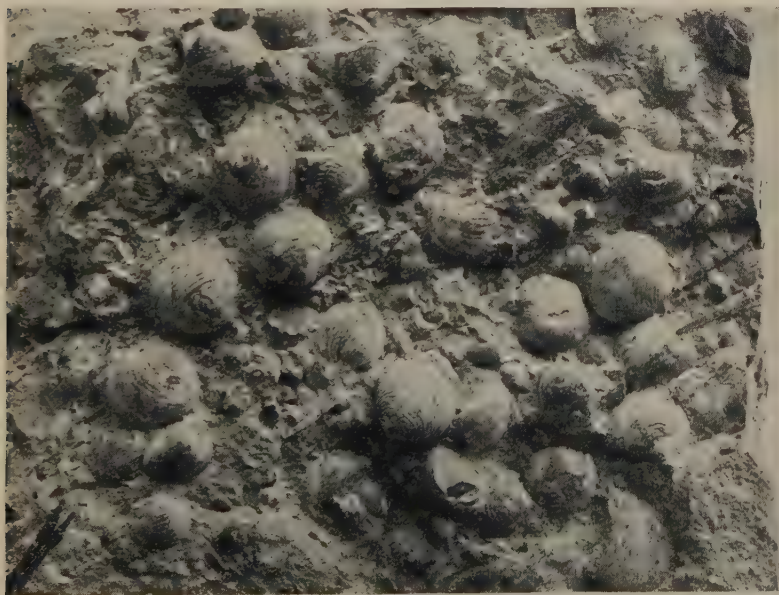
The first land plants had no flowers. But in the Carboniferous Period, after the coal plants, flowers came and insects. These first land insects were not the first animal forms of which we know. Ages before this period, there were living creatures in the ocean, and their remains are scattered all over the world. There were at first minute protozoa, little snails, little clams, little crabs, and, after a while, various other creatures with hard shells, some of them reaching a large size.

There were corals, as well, in the process of forming reefs, and by and by there appeared fishes with shells as tough and hard as those of a turtle. There were also sharks with sharp teeth, or with grinding teeth, which enabled them to bite through the shells of the fishes, or to grind clams and snails in their capacious mouths.

Whenever an animal had a hard shell or hard bones or teeth, its body, when it died, would remain in the sand or

clay and in time might become a fossil. As millions on millions of clams and crabs and fishes have lived in the water, there are millions of them preserved as fossils. The only ones we can get at are those near the top of the earth's crust, but luckily deep-lying rocks have in one way or another been thrown to the surface. When land has been folded in the process of mountain making, the fossils have been brought within reach. Water gets in; rivers make deep cuts; and by and by we have a chance to see what was once down at a great depth in the sea, because that which lay at the bottom has come at last into view. In fact, there is no kind of rock, save some of the very oldest, at which scientists have not had a chance to look.

As ages passed, other living creatures appeared on the earth. Some of them crept into caves and died there; and



Portion of a slab of rock containing hundreds of fossil shells of creatures, similar to the clam of today, which lived in the ocean in the Mesozoic Age. The rock is from the Black Hills of South Dakota.



A scene in Mesozoic times. The huge reptile at the left is a Tyrannosaurus (terrible lizard); those in the family group at the right are called Triceratops (having a three-horned face). (From a painting by Charles R. Knight in the American Museum of Natural History.)

gradually their bones were buried. When we explore these ancient caves, we find the remains of prehistoric wolves, bears, foxes, panthers, and men, as well as many smaller animals.

Around the salt licks too, especially among the Bad Lands along the upper reaches of the Missouri River and its tributary streams, where the creatures of long ago used to come to lick the salt, are deposits of sand filled with bones. The skeletons of buffalo and deer have been found, and of elephant-like mammoths and mastodons, for these gigantic beasts roamed the fields of the Mississippi Valley before any human beings came to disturb them. So the *mauvaises terres* have been very helpful to the scientists, because through them it has been possible to know what the ancient animals were like. Almost every year, as men continue to dig among them, we learn something more about the life of the past.

Thus, in one way or another, we have come to know the different stages in the growth of our continent and the different kinds of animals that lived on the land and in the sea in each different stage. There were many divisions of time, each millions of years in duration, beginning far back before there was any life at all. The first of these divisions is called the Archæan or Archæozoic Age. Then came a number of others, and to each of these is given a wise-sounding name. There was what scientists call the Paleozoic Age, and after that came the Mesozoic, or age of huge reptiles, when there were lizard-like creatures forty to eighty feet long. Other huge reptiles swam in the sea, or moved about like cattle and fed on the limbs of trees. Smaller ones flew like bats in the air. Perhaps the chief reason these creatures died out was because of the extreme changes in climate. It may be, too, that they laid their eggs in the sand and did not watch them; and when little animals like the opossum came upon the earth, they sucked the eggs, and thus the races of great reptiles died out.

Then came the Tertiary Age with its divisions — Eocene, Oligocene, Miocene, and Pliocene. At various times during this age lived mammoths, mastodons, prehistoric horses, and great deer. They too disappeared, as had the huge reptiles of the earlier age. We do not know why they died out soon after the coming of man upon the earth. Perhaps the men of early times helped in the final extermination of the huge beasts, which they hunted and killed for food. The hunter was not nearly so strong of muscle as the animals, but he was full of ingenuity, for he could strike with clubs and throw stones, and could hurl sharp-pointed pieces of flint a long distance. Against him the great beasts could not hold out. Then, as many centuries passed and firearms came into use, it was no longer possible for even the mightiest of the creatures to protect themselves. The whales of the sea were no safer than the fishlets upon which they fed.





The little Eohippus (early horse) that lived in Eocene times. He was about as large as a fox, and had four toes on each front foot and three on each hind foot, instead of the single hoof of the horse of today. (From a painting by Charles R. Knight in the American Museum of Natural History.)

## II. THE DEATH TRAP OF THE AGES

Perhaps the most remarkable place on our continent for studying the animal life of the past is at Rancho La Brea in Los Angeles. Rancho La Brea is one of the famous old California ranches, and on it is a lake of asphalt, which goes back to about the Pliocene Period, the time during which so many strange things happened in the Yellowstone region.

Many huge animals lived in California during the Pliocene Period and the following centuries, among these being large savage beasts of prey, such as wolves, lions, saber-toothed tigers, and sloths, larger even than the bears of today. In addition to these great creatures there were eagles, vultures, and numerous varieties of wading and perching birds.

When any beast or bird stepped upon the soft surface of the asphalt lake at Rancho La Brea, it was made fast, as the



"The Death Trap of the Ages," the asphalt bed of Rancho La Brea, California. Imbedded in it are the bones of various animals that were mired in the tarry lake in times long past.

rabbit stuck to the Tar Baby in Uncle Remus's story. The harder it struggled to get away, the deeper it sank in the thick black mass, until at last it was buried there. Eagles, foxes, and other predatory creatures would watch its struggles, and rushing on it would be entangled in the same way. Nothing that touched the lake of soft tar could ever get away. For many, many centuries the miring of animals in the asphalt lake continued; sloths, bears, saber-toothed tigers, eagles, horses, rabbits, and many other creatures were caught there.

Part of the lake became covered with wind-blown sand, in which desert weeds grew, thus hiding and hardening most of the soft tar, and no one realized that the asphalt bed contained thousands upon thousands of skeletons of entrapped animals.

When in recent years a demand arose for asphalt for road making, the owner of La Brea hoped to sell his abundant supply. Although some of the asphalt was still so soft

that either man or beast stepping on it would have gone down, as thousands of creatures already had gone, certain parts were so stiff that it was possible to get it out. But when several carloads of the black substance had been dug up, it was found to contain so many bones that it had little commercial value, and the digging ceased. Water filled the holes left by the excavating, and gas bubbles were constantly seen breaking on its surface.

Then some scientists became interested in the place, and in 1908 they began digging for bones. Many fossils were brought to light, all so well preserved that it was easy for experts to determine what kind of animal remains they were. And among the saber-toothed tigers, sloths, and horses of the far-off Pliocene Period, were birds and animals of modern types, which proves that the asphalt of Rancho la Brea is what one scientist calls it — “the Death Trap of the Ages.”

### III. EARLY INHABITANTS OF NORTH AMERICA

We do not know when man first came to North America. We have reason to think that his original home must have been far away, in the valley of the Euphrates perhaps, or in some part of central or western Asia. The very first inhabitants on our continent almost certainly came from Asia by way of Bering Strait. There may have been a continuous stretch of land here, ages ago, and man may have crossed it during the Glacial Period, in company with the animals which he hunted; or he may have come across in later times by means of boats in summer or on the ice in winter.

Recent discoveries have shown that men were living in Florida while the huge prehistoric animals, the mastodon and the mammoth, were still there. Implements made by primitive man have been found in a number of places, especially in Ohio and New Jersey, which show that he was living in

America during the period when the ice sheet was slowly melting away.

We know that when man first came to America he had no domestic animal except the dog. He had none of the grains which were used for agriculture in the Old World. These early people seem to have spread over both North and South



A mound at Miamisburg, Ohio.

America, getting their living by hunting, fishing, and gathering wild vegetables.

After a time, probably in Central America, man found that he could raise maize in his own fields where he planted the seeds, instead of having to depend on the grain that grew wild. In this way he tamed, or domesticated, the wild plants, and thus agriculture was started in America.

After these early people became more skilled in agriculture, fairly large settlements developed along the Andes in South America, in Central America, and Yucatan in Mexico. The population spread northward to the region that is now south Utah and Colorado. In all these regions the people erected large stone buildings. They manufactured cotton into cloth and made pottery with beautiful decorations. They were skilled in making gold and silver into ornaments



and other works of art. Copper too was used for various purposes, and in Peru and Mexico copper was combined with tin to make articles of bronze.

In the southwestern part of what is now the United States large groups of people lived together in dwellings which often consisted of several stories and hundreds of rooms. In that region there were many caves and overhanging cliffs. Community houses were built under the cliffs; we now call them cliff dwellings. In the caves these early people buried their dead fully clothed and placed with them foods and utensils. Objects that were left in the caves and cliff dwellings many centuries ago are found there now. The walls of the caves and the overhanging cliffs protected them, and thus these relics of a vanished people have been preserved. It is from these relics that we have been able to learn in great detail what the people possessed and how they lived.

In the region between the Mississippi River and the Allegheny Mountains, many mounds were built by the early Indian tribes. Some of these mounds were probably built for defense, as in the case of Fort Ancient, which we may see today about twenty-five miles northeast of Cincinnati. Others, like the Serpent Mound in Adams County, Ohio, seem to have been built for religious purposes. The numerous stones and metal implements found within this mound are the kind prehistoric tribes used in worship. The mound represents a snake and is nearly thirteen hundred feet long. In front of the open jaws of the snake there is an oval mound which may represent an egg which he is about to swallow.

Mounds are found throughout the Mississippi Valley, and the greater number of them appear to have been constructed by the Indians as sites for their villages. In fact, when the lower Mississippi was first explored by Europeans in 1540, Indians were still living on such mounds.

When men came over from Europe and explored North America in the sixteenth and seventeenth centuries, the

Indian population was spread out thinly over the continent. There were many tribes and many languages. There was great variety in the manner of living. The kinds of houses, style of clothing, utensils, tribal organization, and ceremonies varied in different parts of the country. In the northeast the Indians lived on what they secured by fishing and hunting, together with the produce from the small fields cultivated by the women. In the southeast and the south-central regions, and also among the Iroquois tribes of New York, agriculture was more important.

Just east of the Rocky Mountains some of the tribes lived chiefly on the great herds of bison. In the southwest agriculture was very important. Along the Pacific coast fish, especially salmon, and wild vegetables supported a large population. In the Mackenzie and Yukon valleys in the far north the Indian people were thinly scattered and supported themselves by hunting and fishing.

## CHAPTER TWELVE

### CREATURES OF FOREST AND FIELD

#### I. THE ANIMALS OF LONG AGO



The mastodon, a remote relative of the elephant of today. The mastodon lived in the northern part of the American continent just before the last great ice age, many thousands of years ago. (From a painting by Charles R. Knight in the American Museum of Natural History.)

OVER the plains of North America once roamed many large animals, some of which have passed away entirely while others are nearly gone. There was the mammoth, a huge elephant with upcurved tusks that lived on the prairies long before the time of man. It had long hair and a strong, coarse mane, and its tusks were thick and strong, a little longer than those of the modern elephant, and heavier. This great creature ranged all over the prairie section of North America from Mexico to the Arctic Ocean and was especially numerous in Alaska.

In the prairie country there was also the mastodon, another elephant-like animal, but with teeth different from those of the mammoth. The teeth of the mastodon had

large lobes somewhat like the grinding teeth of other animals, while the mammoth's teeth were flat on top and the hard enamel was curved in loops through the entire structure of the tooth. Between these curves of hard material in the mammoth's tooth was the soft, cement-like substance that usually comprises the inner portions of teeth.

In prehistoric times mastodons were widespread over the earth. Just where they first appeared nobody knows, but many scientists believe they originated somewhere in the Old World and came to America by way of Siberia. It is supposed that their bodies were covered with a thick growth of hair, because in places where skeletons have been uncovered, masses of woolly brown hair have been found.

Just when the mammoths and the mastodons of America disappeared, or what caused them to die out, is uncertain. It is reasonable to think they abounded on the plains after the coming of man, because arrowheads and stone implements such as were used by prehistoric hunters have been found among their bones. Very likely they were exterminated by the first races that lived in America, the predecessors of the modern Indians.

## II. THE BUFFALO AND THE ANTELOPE OF THE PLAINS

The most interesting of the large animals that have lived in the prairie country during historic times, is the bison, commonly called the buffalo, a great beast with short horns and a big hairy head. There was a time when buffaloes



Tooth of a mammoth. The chewing surface is on the right.



*Copyright by J. E. Haynes*

A herd of buffaloes. This is a very small herd compared with the vast hordes that thundered over the plains of the West before the white man came.

ranged the level country all the way from the Alleghenies to the Rocky Mountains. But they were slaughtered recklessly, sometimes for the sake of the hides and meat, sometimes in pure wantonness, vast herds being wiped out in a few months. Now the only ones left of what was an innumerable company are a few thousand in captivity. Colonel William Frederick Cody got his nickname of "Buffalo Bill" because in eighteen months he killed almost five thousand of these beasts, having contracted to supply meat for the laborers of the Union Pacific Railway. Fifty years ago almost every farmer in the eastern part of the United States had a buffalo robe made from the thick tawny fur of one of the great beasts that ranged the prairie country. It was used in the cutter, as a one-horse sleigh was called, and kept people warm during rides over the snow.

Though the buffalo was lord of the plains, perhaps the most beautiful creature of the region was the so-called ante-

lope, a fleet-footed, graceful animal the size of a small deer. When Dr. Jordan first went to California, in 1880, the plains east of the Rocky Mountains abounded in herds of antelope. They could be seen at almost any time from the train, and to watch them bound across the open country with head held proudly erect was a joy to the eye. In herds of several hundred and even more, they moved southward when the snows came, sometimes going as far as Mexico; but with the return of spring and the flight of the birds northward, they came back to feast all summer on the prairie grasses.

The American antelope is now almost extinct. Mountain lions or panthers destroyed many. The Indian hunters killed them off by thousands, and the white sportsmen seemed eager to complete the work of destruction, so that the herds dwindled until now the only specimens left are the few protected ones in the national parks and in game preserves. Today a wild antelope would be a real curiosity.

The antelope is a distinct type which has something in common with both the deer and the goat. It has short, curving, forked horns, and for this reason is often called the Pronghorn. It is a distant relative of the chamois of the Alps and the gazelle, so often mentioned in poetry, and altogether it is so attractive that it deserves every word of praise that has been bestowed upon it.

### III. THE BIG HORN AND THE MOUNTAIN GOAT

High up among the western mountains there are still a few wild sheep, the Big Horn, as they are called because of the immense horns of the males. In Colorado, where for many years it has been unlawful to shoot them, there are perhaps four thousand running wild. But in Montana, Wyoming, Idaho, and Washington, where hunters have been free to kill the Big Horns, there are less than five hundred all told. Unless rigid laws for their protection are passed, these sheep will soon go the way of the buffalo and the Pronghorn.



Big Horn sheep in Glacier National Park, Montana. Through the complete protection in our national parks, we are able to preserve from extinction many of our larger wild animals.

Unlike domesticated sheep, the Big Horn has very little wool. It likes the highest of mountain pastures, and it often mounts to the loftiest cliffs, for it is so sure-footed that it is in no danger of falling. The treeless slopes above the timber line are its summer feeding places, and in winter it paws through the snow carpet to get the tallest of the buried grasses. The Big Horn likes the companionship of its own kind. During the summer it wanders in small flocks high up on the plateaus. It is so wary that, even while feeding, it is constantly on the lookout for beasts that might destroy it. When winter forces it to the lowlands, it keeps as much as possible to the open country. It knows that mountain lions hide in the wooded places, and therefore it avoids the forests.

Although not so graceful as the antelope, the Big Horn is quite as agile and has much more endurance. The grace-

fully built antelope cannot travel a very long distance at high speed, but the Big Horn can; and in strength and swiftness it is the equal of any wild sheep or goat in the mountains of any land.

It is said that these great sheep will leap down from a crag, striking on their horns, and move on unharmed. We once heard the story of a Big Horn which arrived on the edge of a cliff in the Yosemite and leaped off, expecting to strike on his horns. But half way down he espied a camp of hunters beside a spring. Immediately he turned around in the air, and the momentum he had gained carried him at once back to the edge of the cliff from which he started. You do not need to believe every story you hear, at least not in California.

The pride of the Rocky Mountains is the great white goat, a finely shaped creature, not a true goat but more like one than anything else. It has small horns and long white hair, and is found in the wildest and most inaccessible mountain ranges. But even there the hunter too often pursues him, with no higher object than to kill something, and this handsomest of all our wild beasts may be doomed with the rest. What a pity that in our time there should be so much shooting simply for the fun of it! Those who follow us may know little game, except clay pigeons and cloth rabbits which run on rollers and have springs inside for winding them up.

#### IV. MOOSE, CARIBOU, AND DEER

Far up in the state of Maine in the vicinity of Moosehead Lake and in the forest regions of Canada is still to be found the moose, a noble animal, largest of all the deer family. His brothers in Europe are known as elk, but we wrongly use that name for our wapiti or great stag.

The moose is truly the monarch of the wilderness. He spends the spring and summer in the green fragrance of



the pines, roaming the woods and swimming in the lakes, feasting on the juicy plants and lily roots in the marshes along the water's edge. He enjoys the low country where there are birches, alders, and aspens, the bark of which he likes almost as well as the pond lily pads and roots. His favorite feeding ground is among the willows, for the shoots and young bark of the willows are very satisfying. When autumn comes, he leaves these regions and turns to the hilly country, where he browses on evergreens. During the winter he makes for himself and his family a sort of park or preserve among the evergreens by tramping down the snow.

Wolves are the only enemy the moose has, except man; yet even these beasts have little terror for him if the snow is soft, for he is so powerful that he can easily plunge through the drifts. But when a sudden thaw is followed by quick freezing and an icy crust is formed on top of the snow, the moose is in great danger, for since he is a heavy animal, with small, sharp feet, the ice breaks under him and keeps him from moving quickly. Wolves are smaller and lighter than the moose and can run on top of the ice crusts, stealing upon him so that he is taken by surprise; and two or three of these prowlers can make away with a giant bull moose. He understands this; so whenever he discovers that the ice on the drifts will not bear his weight, he moves to the evergreen timber where thick tree growths shut out the sun and the snow is soft and crustless.

The moose is not fond of traveling. He migrates only when the changing seasons force him to seek food, or when civilization has broken into his wild places and he is no longer free in them. Usually not more than twenty miles lie between his summer and winter foraging places, for he never takes long journeys, like some of the wild creatures that gather in great herds and move from one part of the country to another.

In the days when the moose were plentiful, they roamed



Cow and calf moose that have come down to feed on the plants along the shallows of this northern lake. It is only by great skill and good luck that one can get as close to a moose as Dr. Charles M. Whitney was when he took this picture.

more of the forest region of North America than any other large animal, ranging throughout the wooded territory almost as far up as the Arctic Circle. Careless hunting in our own land has reduced the numbers here until these splendid beasts are almost extinct in every state but Maine, Michigan, and Wisconsin. But since the government has begun to protect them by means of game laws, there is hope that they will roam the northern forests as long as the forests stand, for they are hardy and well able to take care of themselves. They are the most cunning of all the deer tribe and the best able to elude their pursuers.

In Maine, too, among the lakes and forests, is found the caribou, which is the small American reindeer, a handsome,

fleet-footed creature that once roamed over the entire northern half of North America. The Indians said they were as plentiful as the leaves on the forest trees. When winter began, the caribou would gather in great herds and travel away from the country of snowdrifts to a region of lighter snowfall, where they were sure to find the mosses, berries, and green things they liked to eat. The Indians knew so well the season of their moving and the route they would take—for they always went over the same trail—that the tribes held as game preserves the various crossings where they forded rivers, and the failure of red hunters to keep strictly to the game territory allotted to their people caused more than one Indian war.

Now all this has changed. Careless hunting has thinned the ranks of the caribou in our country until this great animal family has been reduced to a small one. In some parts of Canada these beasts still move in such numbers at the migrating season that the people speak of them as *la foule*—the throng. In the United States they are no longer found outside of Maine, except for a few in Michigan.

Ernest Thompson Seton says the caribou has both stilts and snowshoes. His long, thin legs fit him splendidly for making his way through the swamps and thickets, while his broad feet, unlike the small, rather sharp ones of the moose, keep him from sinking in either snow or mud. Therefore, when the snow gets soft in the early spring, the woodland caribou, which is the species found in Maine, begins to wander north, for he knows he can make his way on top of the drifts, even if he cannot break through them.

He is just as well equipped for swimming. He swims so high that he seems to be on the lake instead of in it, his graceful head and finely chiseled antlers held splendidly erect; and he is so swift of motion in the water that only the best canoeman can overtake him. In fact, he feels much safer there than on the land. Whenever he scents danger, he

will head for some lake or stream and leap into the water from great heights, even from the tops of cliffs, going down with a mighty splash.

In all parts of our country various kinds of deer are found, some large, some small, but all fleet-footed, friendly, and interesting. Our largest species, the wapiti, popularly known as elk, is still abundant in parts of the Northwest. The finest herds live in the Yellowstone Park, where no one may kill them, and it is said that they know the boundaries of the park as well as the hunters themselves.

## V. PREDATORY BEASTS

Besides these plant-eating, horn-bearing wild animals, America has her full share of predatory beasts, which feed on whatever they may overtake or capture. Preëminent in size and strength stands the grizzly bear, a huge, easy-going, good-natured creature when he is not made angry in some way. He is much larger than the cinnamon bear or brown bear, once common, being more like the great cave bear of Europe and the monstrous black bears of Alaska and western Asia. His traits are well set off in Bret Harte's poem of the grizzly :

Coward of heroic size,  
In whose lazy muscles lies  
Strength we fear and yet despise.

The grizzly, once common throughout the Sierra region, is now almost extinct, as is also the smaller cinnamon bear, which was once widely distributed through all the country.

The gray wolf or timber wolf, a large, fierce animal like a great dog, has also vanished from settled districts. His little, hungry, cowardly brother, the coyote or prairie wolf, "half-bold and half-timid, yet lazy all through," is still fairly common in the West, where he maintains a losing fight with the sheep herders.



The panther — called cougar, catamount, and mountain lion — is a giant cat, brown in color, of tremendous strength and dangerous when alarmed or hungry. It was once common in our forests, but it is now found only in mountain thickets of the West.

## VI. THE PASSENGER PIGEON

The forests and plains of our land have been the home of numerous kinds of wild birds. Some of these birds are now entirely gone, while others have grown extremely scarce. One of the most beautiful of the vanished species was the passenger pigeon. This was a kind of wild dove, blue-gray above, reddish brown below, about the shape of the mourning dove but more than twice as large, and with a long, slim tail, the middle feathers much longer than the others.

A hundred years ago passenger pigeons used to nest in the forests of Kentucky, Tennessee, southern Ohio, and Indiana in such multitudes that when they flew overhead they would hide the sun. It was scarcely safe to go into the woods because the weight of the birds would often break the branches of the trees. Fallen nests, fallen eggs, and fallen squabs could be seen almost anywhere in the woods during early summer. Men used to kill passenger pigeons by thousands, cutting down trees to get them, filling barrels with the birds, melting them down for oil because they were very fat, and shipping them to various cities. Whole barrels of them often spoiled on the way, but nobody worried about that. There were always enough left, for no other bird was ever so plentiful in America.

In 1876, when Dr. Jordan wrote his first work on birds, he gave this description of the passenger pigeon :

Wild pigeon, passenger pigeon ; bluish drab with reddish and violet tinges ; reddish below. Length about seventeen inches, wing seven and one half, tail eight ; eastern North America ; abundant.

He said *abundant*, because he had seen the woods alive with them ever since he was a boy. The next time he wrote of this bird, in 1887, he could get but one new specimen and he wrote, "rapidly becoming extinct." It was disappearing more rapidly than anyone dreamed. On August 29, 1914, in the Cincinnati Zoölogical Garden the last passenger pigeon died. Some years before, several of these birds had been taken to the Garden and were carefully tended there. But Martha, as this one was called, was the last of them, and there will never be any more.



Passenger pigeon, once very abundant, but now extinct.

The passing of the passenger pigeon was a sad loss because it was beautiful, interesting, and valuable to man. The American people, no worse than any other perhaps, but not very much better, have been so scandalously careless about the destruction of wild creatures that there are perhaps not half so many birds in the United States today as there were forty years ago. Since nearly all birds feed on insects, the fewer birds there are, the more insect pests we have to fight. To kill wild birds, with the exception of two or three mischievous kinds, is a costly and criminal waste of valuable life.

Several years ago the Audubon Society, an association of bird lovers and bird helpers, was organized to prevent the destruction of birds. This society has done a great deal to save the birds. It has tried to preserve species still living, and has spared no labor in its efforts, because its workers know that whenever a species is gone it will never come back.

The man who shoots as many wild birds as the law permits him to bring down, just for the satisfaction of the shooting, is about as good an American as the lumberman who, in taking off the brush, slaughters an entire forest and leaves a waste behind instead of a noble wilderness. The woman who adorns her hats with plumes that have been obtained by the sacrifice of some bit of wild life is not a whit more thoughtful.

I saw with open eyes  
Singing birds sweet,  
Sold in the shops  
For the people to eat.  
Sold in the shops  
Of Stupidity Street.

Thus wrote a poet and bird lover, Ralph Hodgson, about the slaughter of beautiful flying things. He told the truth. People who eat singing birds or who kill them for sport live in Stupidity Street; for when they do it, they rob the woods and fields of song, which means robbing the lives of their neighbors of one of their finest joys. Nothing could be more stupid or more selfish than that. If you don't believe it, read Longfellow's poem, "The Birds of Killingworth."

## VII. OUR LARGEST BIRDS

Largest among all our birds is the stately California condor, a huge vulture-like fowl which now nests only in cliffs of some of the California canyons, especially the "Pinnacles" of San Benito County, but it was once widely diffused through the West. It is black in color, with naked head. It is most notable for its great power of flight, its spread of wing being from nine to eleven feet.

Among predatory birds we have numerous species of owls, hawks, and falcons, the strongest of these being known as eagles. The largest and most dignified is the golden eagle, the emblem of imperialism in France under the Napoleons,



A fine specimen of the bald eagle. Note the strong curved beak, which is used for tearing prey. The bird is not really bald, but gets its name from the white feathers on its head and neck, which appear in the third year and give the appearance of baldness when seen from a distance.

and in Russia, Germany, and Austria. It is a powerful bird, found in all northern regions and known at sight by its legs being feathered to the toes. There is no white on the head.

The bald eagle, also a majestic bird, has its head white (not bald) after its third year, and its lower leg is unfeathered. It is found in North America but not in Europe. It is less particular in its behavior than the golden eagle, and picks up much of its living in pursuing the smaller osprey or fish-hawk and forcing it to drop its captured fish. The bald



eagle was first selected as the emblem of our republic. Recent coins, however, carry the figure of the somewhat nobler golden eagle.

A bird that was formerly abundant in the woods of New York was the wild turkey, which Benjamin Franklin said was the finest of our birds. He wished to have it used as our national emblem instead of the eagle.

Wild turkeys once roamed the hills all the way from Ontario to Mexico, and in the early days were so plentiful that the farmers could get them anywhere in the woods and hills. They were hunted to such an extent that they were almost exterminated outside of Mexico. Indeed, if some of these Mexican birds had not been raised in captivity and become common barnyard fowls, few of us would know what a turkey is like.

#### VIII. THE BEAVER AND THE MUSKRAT

Along the shores of Lake Superior, as well as on the streams of Maine, Montana, and other northern states, and even as far south as Arizona, "the beaver builds his lodges." This is one of the most ingenious animals living upon the earth today, his unique habits raising him far above all related creatures. He is one of the most delightful to watch and study, as with wonderful instinct, directed by real intelligence, he constructs his curious home exactly to suit his fancy. He toils with all his might at cutting down trees and then recutting them until he has pieces exactly the size he wants. When his lumber is prepared, his work has just begun, for then it must be piled up into a lodge, plastered with mud, and made cozy according to beaver standards.

Because the beaver likes the water quite as much as the land, and is so made that he can be in it with perfect comfort, he builds partly in a pond or stream. That means that he must erect a dam, which requires a tremendous amount of work. It is beaver style to have tunnels extend-



A beaver at work repairing a dam. If the water level of the pond falls, the beaver looks for a break in the dam and immediately repairs it.

ing into secret parts of the forest where refuge may be had from wolves, lynxes, and foxes. And dams and tunnels cannot be made without a great deal of hard labor.

The beaver is well able to perform all the work that is necessary, for he has a set of teeth that are better for his purpose than the finest saw ever made. Men who have patiently studied the ways of these little architects have found them sawing away at trees day and night.

Beavers live on water plants, vines, and bushes whenever they can find them, and during the months between October and May, when the forests are snow-carpeted and green food is not to be obtained, they nibble tree bark. They like especially the tender roots of water lilies and the white bark of the aspen. Sometimes they make tunnels from their lodges to growths of aspen trees, and transport their food by an underground route. More often, when conditions are



A well-constructed beaver dam in Estes Park, Colorado. The sticks and logs used in making the dam are carefully piled by the beavers in such a way as to withstand the pressure of the water. Stones and earth are also used to make the dam solid. In the background the lodge of the beavers may be seen.

favorable, they dig canals, down which they float their cuts of aspen. In Montana some of these food canals are an eighth of a mile long.

An animal not so interesting as the beaver, but much like him in some ways, is the muskrat, a smaller beast who makes his home partly upon the land and partly in the water. He lives in simple houses or burrows which he builds along lakes and streams. He builds very cleverly, and always has at least one tunnel, for his home must have an entrance below water, if he is to escape creatures that like to feed on him. Whenever he is pursued, he rushes for the passage that will take him into the lake or stream by a route they cannot follow.

The muskrat has numerous woodland enemies because his flesh is tender and palatable, and there are always creatures ready to eat him. In fact, human beings find him very good food also, for in spite of his name he is not a rat.

#### IX. MARMOT, RABBIT, SQUIRREL, AND CHIPMUNK

The marmot, which goes also by the name of woodchuck and ground hog, is another animal worth knowing. He makes his home by burrowing in the ground. Although he is not so clever in his building as the beaver or even the muskrat, he does not need to be, for the hole he digs is high and dry, and serves for a home quite as well as one more artfully fashioned.

This animal sleeps during the winter, and there is an old notion that on the second day of February the "ground hog" always comes out to take a look at the weather. If he sees his shadow, he goes to sleep again, because instinct tells him that warm days are still six weeks away. If he does not see his shadow, he stays out. All of which is another way of saying that, according to an old-time superstition, if the second of February is a sunny day, cold and wintry weather will follow; while if it is not bright and warm, spring is about to begin. In some parts of America, this day is known among boys of various ages as ground hog day.

The rabbit, the squirrel, and the chipmunk are cousins of the marmot, and in all their species are thoroughly charming. The commonest of the rabbits is the little cotton-tail, colored like dead leaves, the white tail sticking up as a "recognition mark" to encourage other little rabbits. Many kinds of animals, including birds and fishes, have some mark easily seen, which is supposed to help those of a kind to keep together. Such is the black tip of the weasel's tail, the scarlet mark on the red-wing blackbird, the white tail feathers on the meadow lark. We do not know that these marks



were given with such intention or even that they serve such a purpose; but at any rate they help *us* to recognize the creatures, whether they help the animals or not.

Most interesting of the rabbit tribe is the varying hare, or snow-shoe rabbit, of more northern regions. This is a large and handsome rabbit, gray and brown in the summer, colored like dead leaves and grass, but pure white in the winter when the snow falls. All animals renew their hair or pelage in the fall and spring, and those that live in snowy regions have a winter color that matches the snow. This arrangement is called protective coloration and serves to preserve the rabbits from foxes, weasels, owls, and other predatory animals and birds. Most of their enemies also turn white in winter. Nearly all creatures which roam over the snow, whether hunting or hunted, are clothed in white.

Another noted member of this tribe is the jack rabbit of the western plains, lank, long-legged, and swift, with the ears very high, narrow, and sensitive.

Squirrels abound in all our forests — gray squirrels, flying squirrels, larger fox squirrels of the West and South, still larger silver squirrels of the California mountains, and the delightful red squirrel of the Atlantic seaboard. Smaller than tree squirrels are the friendly chipmunks, with black stripes along their backs, one kind in the East and a dozen or more in the forests of the West.

But if we were to tell you all there is to tell about these little creatures and about the foxes, raccoons, opossums, bobcats, and the rest of the wild animals, it would make a very large book. The creatures of forest and field are now very few compared with the number that were here when the Pilgrim Fathers came. If the Americans of the future are to be gladdened by bird songs and by the sight of delightful wild things, the Americans of today must see to it that the species still existing are kept alive. Each individual should do his part toward protecting them. Hunting should be

done chiefly, if not wholly, with the camera instead of the rifle or slingshot, so that the squirrels, beavers, and wild rabbits, the bobolinks, mocking birds, cardinals, wood warblers, robins, and meadowlarks may continue to enjoy our woods and fields, and be a source of pleasure to the people who shall live after us.

## CHAPTER THIRTEEN

### THE LIFE OF STREAM AND SEA

#### I. THE WAYS OF FISHES

THE creatures of the ocean are just as interesting as those that live upon the land. Under the ripples of the lakes and rivers and among the waves of the sea are millions of fishes and other water animals, each species of which does its work according to the ways of its kind. The chief business of the fishes is the laying of their eggs to keep the species from dying out, and in living their lives and doing their work they have many strange adventures. Some of them are great travelers; some, just stay-at-home folk. But they are all constantly struggling for existence, because there is even more greed among them than among human kind. The life of the water is an eternal battle between the weak and the strong, and few of the creatures, not even the sharks and the tunas, are large and powerful enough to be quite safe. While the mackerel pursues and devours the little herring, the mackerel shark mercilessly speeds after the mackerel, eating him and many of his brothers before he is satisfied. The Chinese have a proverb, "Big fish eat little fish, little fish eat shrimp, shrimp eat mud." This is the basis of the following tale which Dr. Jordan once wrote to tell "How the Flounder's Mouth Got Twisted."<sup>1</sup>

Once there was a great deal of trouble among the fishes. The big ones ate the little ones, and they had to keep running all the time so as not to be eaten by the still bigger ones; and when the little fishes would catch those that were still smaller, they would eat them too. There was so much eating and quarreling and trouble that the fishes made up their minds to have a king who would keep them all in order. One day they agreed among themselves that the one who swam

<sup>1</sup> In *The Book of Knight and Barbara*.

fastest and reached the shore first should be king of all the fishes. This was because the swift fish would be able to help the little fish soonest when some big fellow tried to eat him up.

They all stood in a row out in the sea and waited for the word to go, and then they swam as fast as they could towards the goal, bass and mackerel, sunfish, mad-tom, Moorish Idol, and all the rest of the fishes, the little sea horse with the others, each swimming with all his might to see if he could reach the shore first.

After a while one fish got to the goal ahead of the rest, and the other fishes flapped tails to cheer him. It was the herring who was swiftest, so he was made king. Flounder, away behind all the others, for he swam very slowly with his face down towards the bottom of the sea, could not see who had won the race. So when he heard the tails flapping to cheer the king, he called to Sea Horse, who was nearest him, and asked, "Who is it they are making king?"

Sea Horse called back, "Herring won; and now he is king of the fishes. Three cheers for Herring! He is all right."

And the others echoed, "Who is all right? Herring!"

Flounder was envious and twisted his mouth on one side because he wanted to be king himself. Then he said, "The naked little herring!" and looked as cross as he could with his mouth all on one side.

When Herring, who was king of the fishes, heard what Flounder said, he issued a decree that Flounder should wear his mouth on one side forever afterward by way of punishment. And he wears it that way to this very day.

## II. HERRING AND HERRING-LIKE FISHES

Herring, of one kind or another, exist in greater abundance than any of the other creatures of the sea. They are weak little fellows, having practically no teeth and no capacity for fighting any other fish, so they stand a poor chance of hold-





Fishing schooners at Gloucester, Massachusetts. They have just come in from Newfoundland loaded with herring.

ing their own in the warlike life of the ocean. But the herring lay their eggs in such great schools that all the fishing that has been done, and all the feasts they have made for mackerel and cod, seem not to have diminished their numbers.

Herring-like fishes are found in every sea, but the kind that we use smoked and dried does not range far south of the latitude of New York and San Francisco. Off Norway, Ireland, Scotland, Maine, and Newfoundland, and also in southern Alaska and northern Japan, they are very abundant. In the regions where these fishes abound, the business of catching and preparing them for the market is the chief industry of the people. The Norwegian writer, Björnson, says that whenever herring schools touch the coast of Norway, towns spring up as though they were driftwood scattered along the shore, so important is the herring fishing in the lives of the people there. In New England, too, along the coast people

make their homes close to the place where the herring run. A minister who some years ago lived among the fishermen on the Isles of Shoals, just off the shore of New Hampshire, tells us that he was never certain of having an audience through to the end of the service, as it was no uncommon sight to see the entire congregation rise in the midst of the sermon and dash from the church because a school of herring had been seen in the offing.

The sardine is a herring-like fish with flesh much more delicate than that of the herring. Some of the different species of sardines are found in almost all warm seas, but they are especially abundant in the Mediterranean, where the young are put up in tins filled with olive oil. The full-grown fish are called pilchard, a name heard especially in the south of England. Sardines are very numerous on the coast of southern California. They are canned in great numbers at Monterey and also at Long Beach, but here the grown fish are put up in oil instead of the very young ones, as is the case along the Mediterranean, because the young ones do not come in such numbers to the shore. But big or little, the sardine is a valuable fish food of much delicacy.

### III. CODFISH AND HADDOCK

Off the northern New England coast the codfish abounds, and it ranges the North Atlantic on both sides, as well as Bering Sea and the waters around Alaska.

The cod is a cold-water fish that lives near banks of sand in shallow parts of the sea. It does not like to migrate, but stays as close to one vicinity as the seasons will permit. It lays its eggs in the water and they rise to the surface and float until they are hatched, so the cod mother never knows anything about her children. In fact, she is so busy getting food for herself that she has little time to devote to anything else. Her favorite dish is clams, and she swallows

big ones, shells and all, having no more fear of her stomach than an ostrich.

Codfish are found plentifully on the banks south of Newfoundland. There the fishermen from Gloucester and other New England ports seek the schools of cod. Cod fishing is a hard business, and those who follow it often have wild experiences before they get back to the home shore. In two-masted sailing vessels, or schooners, they go to the shallow places along the Georges and other banks, and as the North Atlantic is very stormy, it not infrequently happens that men are washed overboard and lost. A half-masted flag on the schooner proclaims the sad news to the village as it sails back to port. Sometimes there is no homecoming, for both ship and crew may be swallowed up by the wild ocean around the Newfoundland banks.

To catch the cod, the fishermen use a trawl, which consists of a long, strong line held up in the water by means of buoys; to this line many short lines are fastened, each with a baited hook at its end. After the hooks have been set long enough for the fish to have taken them, the men row out from the schooner in small dories and haul them in. Sometimes a trawl line is fastened to a rapidly moving boat and drawn along behind it. Occasionally the trawl line cuts loose from the buoy or boat that holds it, and with a hundred or more fish attached goes floundering through the ocean. Then there is great activity among the fishermen, as they work to get it back again.

Sometimes a beam-trawl with a scoop-net is used in cod fishing. This is a long, net-like bag with a square framework at the mouth, which is weighted and dropped into the sea. After being dragged along for a distance, it is brought up filled with fishes.

The flesh of the cod has little taste, but it takes salt finely, and most of those that come to our tables have been salted and dried. The salting and the packing are done when the



Drying codfish in a flake yard at Gloucester, Massachusetts.

men get back to the villages with their cargoes, and everybody must lend a hand. Women and children bustle about as industriously as the fishermen themselves, spreading the catches on raised platforms to dry, and turning them often so they will cure evenly. These platforms, which are called flakes, are set so close together that during the drying time the beaches look as if they were covered with white canvas.

Another fish that frequents the New England shores is the haddock. It lives close to the cod; and anyone can tell it from the cod because of a narrow black stripe along its side which extends like a line of ink from head to tail. Like the cod, the haddock has white and tasteless flesh, but in the north of Europe people discovered that, when smoked and salted, it became really appetizing, and great numbers of haddock have been prepared for market in this



way. A common name for haddock thus prepared is finnan-haddie, a Scotch corruption of "Findon haddock," Findon being a fishing village near Aberdeen.

#### IV. MACKEREL, TUNA, AND TARPON

In the north Atlantic the mackerel run in summer in great abundance. They move northward from the Gulf Stream, touching the coast of Maine, New Hampshire, and Massachusetts, just as on the other side of the ocean they strike the shores of the British Isles. Whenever they venture close to land, they are caught in great numbers and salted.

The mackerel is a swift-swimming fish with a long, strong tail propeller. It lives on herrings and other smaller fishes, which it runs down easily. While it is pursuing its own victims, it has to work hard and fast to keep out of the way of the mackerel shark, a big fellow about fifteen feet long, which pursues it even as it does the herring, and feasts upon its delicate flesh.

The albacore is a large mackerel-like fish found in most of the warm seas but especially around the islands of southern California. It reaches a weight of twenty to sixty pounds, and is distinguished from all other mackerel by a very long pectoral fin, which is the fin on the side, behind the head. This reaches back like a long black ribbon for most of the length of the body. The albacore has white flesh, delicately flavored, and is put up in tin cans in great numbers, along with various other mackerels, under the name of tuna, although the real tuna is a different fish from the albacore.

The tuna is a still larger member of the mackerel family, weighing from two hundred to six hundred pounds, and its pectoral fin is short, not ribbon-like. The flesh of the tuna is red and very oily, not so delicate as that of the albacore, although it is canned as a condiment. The tuna is the greatest of game fish. It will attack with great energy



Hauling fish from a pound net off the coast of Cape Cod.

a strong hook or a heavy line trailed behind a boat and is a worthy antagonist of the angler.

The tuna is called tunny in England. It is found in all warm seas, but is especially abundant around Avalon on the island of Catalina, just off the coast of southern California, the world center for great game fish. Here is found also the great jewfish, which is a bass with a head almost as big as a bushel basket, the swift yellow-tail or amber fish, the great swordfish, the marlinspike fish, which is a smaller kind of swordfish, and the yellow-finned albacore, which comes across from Japan.

Along the coast of Florida is found a famous game fish called tarpon. Its flesh is soft and of little flavor, but because it is a vigorous fighter and a big creature, reaching a weight of forty pounds and more, it is much sought by sportsmen. It leaps high into the air when caught, and altogether gives the angler an exciting battle. The scales of the tarpon

are very large, larger than those of any other fish whatsoever, while those of the tuna are exceedingly small, imbedded in the skin.

## V. SHAD AND PIKE

Some fishes spend all their lives in the ocean, and some never leave the lakes and streams in which they were born. There are others that pass part of the time in the rivers and part in the sea. Among these are salmon and shad.

The shad is a herring-like fish, larger than the herring, heavier of body, of fine flavor, but full of little bones. There are shad in Europe too, but the American variety, the best of all, is found native only along our Atlantic coast. It spawns in the larger rivers, going up in the spring to deposit its eggs. By the time the apple trees and shadbush are in full bloom, the fish are running abundantly in the streams, casting their eggs under the clear bright ripples, and then they go down to the sea again.

When the young shad are hatched, they stay in the rivers throughout the summer, until they are three or four inches long. But about the time the forests brighten with the first frosts, they go down stream to become ocean dwellers instead of fresh-water fish.

In 1877 the United States Fish Commission introduced shad from the Potomac River into the Sacramento River of California. From the Golden Gate they wandered northward and at Astoria, near the mouth of the Columbia River, the senior author of this book had the good fortune to secure the first shad caught in the Pacific. He preserved it in alcohol and sent it to Washington, and doubtless it can still be seen there in the National Museum. Since then, the shad has increased greatly and ranges all the way from Monterey to Alaska, the number now in the Pacific being doubtless greater than was ever the case in the Atlantic.

In the New England rivers there are pike or pickerel, as this fish is usually called in America. The pickerel is one of the most regularly formed of fishes and very handsome, with the gleaming gold reflections of its scales and its bright red gills. It is one of the swiftest, wariest, and most ravenous of fishes, so greedy that it will swallow a frog or a fish at one gulp. Thoreau tells of catching one that had just feasted on a pickerel half as large as himself, the tail of which was still visible in his mouth while the head was already digested in his stomach. He says also of this eternally hungry fish: "Sometimes a striped snake, bound to greener meadows across stream, ends its progress in the same receptacle [the mouth of the pickerel] and sometimes the pickerel himself, in his eagerness to snatch a fly or insect, comes to grief, for he will snap at a hook the minute it is cast." It is pickerel fashion to lie under a rock or lily pad until something interesting is seen, and then to dart out and snap at it with the certainty that the victim cannot escape.

There are several kinds of pickerel in America, ranging from a foot long to six or eight feet. The giant of this family is the huge Muskallunge or Maskinongy of the northern waters, a monstrous machine for the seizure and absorption of other fishes.

## VI. SALMON

The name *salmon* is applied to two very different types of fishes, the one of the North Atlantic, the other of the North Pacific.

The Atlantic salmon is much like a very large trout. It is a handsome, black-spotted fish, and when of average size weighs about fifteen pounds, but sometimes becomes much larger. It lives in the sea, chiefly near the mouths of rivers; but when the woods turn scarlet in the fall, when wild geese begin to wing toward the warm southlands, and the water in the streams grows cool, the salmon knows winter is com-





A humpback salmon leaping over Litnik Falls, Afognak Island, Alaska. Salmon often make leaps of ten feet or more, in an effort to get above the falls of a stream.

ing, and it has work to do before the days of snow and ice arrive. So out of the sea and up a river it swims to spawn, for all salmon cast their eggs in fresh water, the eggs hatching as the water grows colder. Most other fishes spawn in the spring, and the eggs hatch as the weather grows warm. Cold water hatches the salmon eggs, at least in most of the species.

Sometimes in the course of its travels it goes into a lake, if the river leads to one, and sometimes it happens that the fish cannot, or does not, get back to the sea. Then it becomes land-locked and dwarfed in size, because in the lakes

it has neither so much food nor so much space as in the ocean.

Salmon that do not become land-locked go back to the sea after their eggs are laid, drifting tail foremost as they move down the streams. The young fishes that have been hatched in the rivers also travel to the ocean, drifting tail foremost. They stay in the sea until they are full grown, and then they too swim up the rivers to deposit their eggs.

One of the famous haunts of land-locked salmon is Sebago Lake in Maine. Although the fishes of this body of water are not so large as their cousins who live in the ocean, they are just as handsome, and they still keep the habits their parents brought when they swam inland. With the approach of autumn, they too swim up the streams that flow into the lake, to cast their eggs, and then they travel back to Sebago, which is their ocean. In April the young ones that have hatched in the little rivers drift down to the lake, and there they stay until they are old enough to spawn, when they go up stream as their elders did.

Along the western coast of the United States, especially around the mouth of the Columbia River, are multitudes of salmon of a very different type, millions upon millions of them. The salmon of the Pacific differ from the Atlantic salmon in their bony structure, but especially in the fact that they produce but one series of eggs or germ-cells, and all of them, male and female, die soon after spawning.

There are five different species in our Pacific waters. The king salmon, called Chinook, is the largest, varying in weight from sixteen to eighty pounds. This is the famous fish of the Columbia River. It runs in large numbers also in the spring in the Sacramento River and in the Russian River, the Eel River, and the Klamath, as well as in Alaska and British Columbia. Some king salmon ascend the Salinas and the Carmel, while very rarely a stray one is found in the Ventura, farther south. Besides being the largest mem-

ber of the salmon family, the king salmon is also the richest in flavor.

The red salmon of Alaska, also called Sockeye or Blueback, is smaller than the king salmon, and its flesh is very red. It is the most abundant of all salmon, swarming throughout



Seining for salmon near Astoria, Oregon, at the mouth of the Columbia River.  
Horses are used to tow the heavy nets to the shore.

the rivers of Alaska and southward to the Columbia. Put up in cans, the red salmon is the chief salmon of commerce.

A strange feature of the life of the red salmon is that it never enters a stream that has no lake in its course. It always deposits its eggs in a stream at the head of the lake. The young spend their first year in the lake. Afterwards, tail foremost, they drift back into the ocean, returning to the lake at the end of four years. How these fishes recognize a stream with a lake is an unsolved puzzle, but they never are seen in any other, and most of them get back to the lake above which they were born.

The other salmon of the Pacific, less valuable and less interesting, are known as the silver salmon or Coho, the calico salmon or Keta, and the humpback salmon.

The king salmon and the red salmon are sometimes called the noble salmon, because they are the largest and swim farthest. Sometimes a thousand to fifteen hundred miles intervene between the sea and their spawning beds. They usually (not always) breed the fourth year, and after spawning, every one, male or female, dies. The stomach shrivels and body cells lose their substance, and they could no more be revived than a dead cornstalk.

## VII. TROUT

The trout is a dwarf salmon, the most beautiful of all freshwater fish, and the special joy of the angler.

There are many different kinds of trout. All are slender and gracefully shaped, and all are spotted, some flecked with black, some with red. The brook trout of the East is grayish or greenish in color, much marbled with olive, and its spots are bright red.

Much like the eastern trout is the Dolly Varden trout of the streams of northern California and northward to Alaska and Kamchatka. It is plain brown or greenish, with red spots on the back and sides, and is extremely vigorous and voracious.

The trout with red spots only and very small imbedded scales are different from other trout in the bony structure of the mouth. In Europe such kinds are called chars, and the char is the noblest of trout.

To the west of the Rocky Mountains, and in Alaska, Siberia, and Europe, there are many kinds of trout—all spotted with black, not red, and with silvery scales large enough to be plainly traced.

The rainbow trout, energetic and gamy, lives in the coast-wise streams of California and Oregon. It is the best-known of all our many western species. When it can run down to the sea, it does so, returning big and fat from its travels, and





A fish hatchery for trout, at Bozeman, Montana. The fish are graded according to age, all those of nearly the same size being placed in one section of the tanks, the next larger in the next section, and so on. A stream of cold water is kept constantly running through the tanks.

it is then known as the steelhead. The grown rainbow trout always has a broad rosy stripe along its side.

The Shasta rainbow trout lives in the mountain streams that flow into the Sacramento. It is much like the other rainbow trout but its scales are smaller. Most of the rainbow trout eggs sent East are of the form known as the Shasta rainbow. These come from the hatchery at Baird, on the McCloud River near Mount Shasta.

The Kern rainbow trout lives in the mountain streams of the San Joaquin and Kern rivers. It is more spotted than either of the other rainbows, and is one of the finest of trout.

In the Kern basin certain tributaries were crossed long ages ago by a lava dike. The trout above the waterfalls made by these dikes have been so long shut away from their brothers and cousins that in each of four different streams a

distinct species has been formed, all of them bright orange red. These are known as the golden trout. They are the Aguabonita golden trout, the Roosevelt trout, the White trout, and the Rose trout, the last two named not for their color but for their discoverers, Stewart Edward White and Wycliffe Rose.

Very likely trout are descended from some variety of land-locked salmon. Nobody knows when they were first separated from their ancestors, but since the time of their origin, very long ago, trout have traveled up and down the rivers, along the sea and then up some other river, until they have reached from Scotland to Chihuahua, from Montana to the Pyrenees. Whoever seeks them honestly within this range will find a large reward. Whether he catches trout or not, it does not matter. He will be a better man for the breath of the forests and the wash of the mountain streams in which the trout makes his home.

## VIII. THE OYSTER AND THE CLAM

The oyster is a sluggish little creature which lives in a shell made up of two parts or valves. It begins life as a spat, a tiny object that looks like a white dot and is less than the size of a pinhead. It soon anchors itself to a piece of stone, bone, shell, or other convenient surface, and remains fastened there for the rest of its days.

Oysters do not grow in the open sea or in rivers, but prefer the brackish mouths of streams yielding plenty of oyster food. For this reason, Chesapeake Bay, which receives the waters of half a dozen rivers and has all the qualities of a good home for these little creatures, is the greatest oyster-producing center of the world.

Oysters of different kinds are found in many regions. They abound along the eastern and southern coast of the United States from Cape Cod to Texas, and on the Pacific

side of our continent at the mouths of some of the streams. Oysters are found also in the waters of the British Isles. The eastern American oyster is one of the largest species, while that of England is quite small, not half the size of the species that makes its home in the waters of the Chesapeake. The Pacific coast oyster also is very small.

The native home of the American oyster is along the mouths of streams flowing into the Atlantic, but it has often been transplanted to other regions. Large numbers have been taken to California and Washington and planted in the bays, where they grow rapidly, but for some reason they never develop spawn, or lay eggs, on the Pacific coast. It is thought the reason for this is that the water of the west coast is much colder than that of the east. Oysters must be replanted each year in Pacific waters to maintain the oyster industry there.

Oysters grow in immense numbers, but they are so crowded that many of the young ones die. Then, too, the starfish takes a great many, as it feeds largely upon them. Only a small part of the oysters that begin life are able to reach maturity.

In the Gulf of California and southward is found the pearl oyster, a large oyster-like creature with a shell of a delicate pink color. This shell is used in the manufacture of buttons under the name of mother-of-pearl, and within the shell are sometimes found beautiful pearls.

The pearl is a secretion deposited by an oyster within its shell whenever there are certain kinds of irritation, especially that due to minute parasitic worms. Almost any oyster is likely to contain pearls, but only pearls of certain kinds and of pure luster are valuable. Some of the pearls found in the shell of the pearl oyster are worth a very great price. It is said that near the head of the Gulf of California about a century ago there stood a church in which was a chest filled with pearls of marvelous beauty taken from oysters found close



Young oysters which have fastened themselves on a willow twig that hung down in the water on the shore of Delaware River, near Bivalve, the famous oyster village below Philadelphia. These oysters have had considerable growth since they attached themselves to the twig. In Havana, Cuba, oysters are often brought to the table attached to twigs of mangrove.

by, and that the worth of the jewels in the chest made this church the richest in northern Mexico.

A Japanese professor has invented a way to irritate the pearl oyster so it will deposit the secretion that hardens into pearls, and pearl farming has become an important industry in Japan. Pearls made by forcing the oyster to deposit the secretion are not considered so valuable as the best of those that are formed naturally. There is, however, no real reason for this discrimination, as they are of the same substance and often equally beautiful.



Pearls are found also in fresh-water mussels, which are abundant throughout the middle western states. A curious thing about these mussels is that the young spat fastens itself to the gills or fins of a minnow or other fish and lives there as a parasite until he is big enough to move about in the bottom clay of the stream. Mussels of this kind have no food value, but buttons can be made out of their shells, and perhaps one in thousands will produce a beautiful pearl.

Clam fishing is an industry that is carried on along both the Atlantic and Pacific coasts of North America. There are many kinds of clams, all built a good deal like the oyster but they have power of moving about. Some clams grow to a very large size. The giant Tridacne of the South Seas carries upwards of five hundred pounds of shell, very thick and white.

## IX. WHALES AND SHARKS

The greatest creatures of the sea are the whales, which are not fishes but mammals, as we call creatures that bring forth their young alive and nurse them with milk.

The great whale of the north, called the right whale, is toothless, but it has a series of large horny structures at the back part of the roof of the mouth that serve as strainers for the small sea creatures upon which whales feed. From these horny structures is taken the whalebone of commerce.

Beneath the skin of a right whale there is a thick coat of blubber, or coarse fat, rich in oil. Whale blubber is a staple food of the Eskimo tribes, and whenever the native hunters are fortunate enough to kill one of these sea monsters, the entire village has a feast.

In many parts of the ocean are found the humpback whale, the still larger sulphur-bottom whale, and numerous smaller species, the smallest of which is called blackfish. Whales are sought by men who go out in boats, or more effectively



A group of old-time whaling ships near one of the Hawaiian Islands in 1833. This scene shows the most dangerous part of the whole cruise, when the men took to the open boats and pursued the whales until they were subdued and towed back to the ship. The painting was made by a man who was on board one of the ships at the time.

by men in stations along the shore where watch is kept for the spouting of the whale, for whenever this great creature rises to breathe, it blows up a stream of water which looks like a fountain playing in the sea.

Whaling stations are found up and down the coast of California, where the humpback, the sulphur-bottom, and the blackfish occur. Although these species have no whale-bone of any consequence, they are rich in oil and are therefore valuable.

In the early days whales were caught by hurling into them spears attached to a rope. This method, called harpooning, is still employed somewhat, but now, instead of being hurled by hand, the spear is fired from a kind of cannon. The most commonly used method of catching whales is to fire into them explosive bombs, which kill instantly.

From Nantucket and New Bedford, Massachusetts, have come the most famous whalers in the world. At first the men hunted offshore, the Indians assisting them and teaching them how to throw the harpoon. They became very skillful in bringing in whales, and during the eighteenth and nineteenth centuries, when whale oil was used wherever oil was needed and the demand was very great, they sailed to the Arctic Seas to supply the needs of their fellow men. But when people began taking another kind of oil from the ground, the demand for whale oil decreased and the men of New Bedford and Nantucket gradually turned to catching cod, mackerel, and herring. But still they like to talk about the old thrilling times and to recount some of the yarns their fathers told of whaling.

Besides the true whale, there are the dolphin, the porpoise, the grampus, and the killer, which is a small whale with wolf-like mouth and strong teeth. The killer is a ferocious beast with a high fin on its back. It is destructive to fishes, sea lions, and fur seals.

Sometimes a killer attacks a great whale, and then the whale will rise in the water and whirl round and round to get rid of its tormentor. A fight of this kind, seen off Santa Cruz, California, was photographed by an artist who happened to be in sight. This is the only authentic picture known of killers attacking a whale. "Such fights used to be ascribed, not to the killer, but to the swordfish, which strikes from below, and to the thrasher shark, which flails from above." But the thrasher shark is a rather sluggish creature, incapable of anything of the kind, and the swordfish swims about all alone asking no one's coöperation. While it may use its sword to thrash about among the herrings, it has no teeth and could not bite the whale's thick skin. In the copy of this photograph on page 311, you can see the swarm of shearwaters, or whale-birds, which crowd about for their share of the wreckage.



Humpback whale attacked by killers off Santa Cruz, California; photographed by W. W. Richards. A flock of shearwaters, eager for spoils, is hovering around the fighting monsters. Note the dorsal fins of the killers in the foreground.

Next to the whales, the largest creatures that live in the sea are sharks, none of them as large as the largest of the whales, but giants compared with most of the other creatures that swim. The largest of the sharks are the basking shark and the whale shark, each of which reaches a length of forty feet and over. These, however, are sluggish creatures, so inactive that they seem like logs. Occasionally they are caught because they are valued for the oil found in the liver. Another large shark is the great white shark, or man-eater, which sometimes reaches a length of forty feet and has saw-edged, knife-like teeth over an inch long. This shark is known to attack man and is found in all warm seas, but fortunately never in large numbers. The senior author once obtained at Soquel, California, a specimen thirty feet long that had a young sea lion in its stomach. The flesh of the shark is little valued. There is one kind, however, with fin rays which make excellent soup much liked by the Chinese.





A sea-devil, a deep sea angler. He carries his headlight among the feelers attached to his dorsal spine.

Sharks are not always large or dangerous. In the deep seas off the coast of Japan is a sharklet which does not exceed a foot in length. It is a jet-black creature with a large luminous patch on each side that shines so that it can see its way in the darkness of the great depths as well as if it were carrying a lantern. Professor Peter Schmidt of Petrograd once took one of these sharklets on a dark night, put it alive into a glass container, and drew its picture by its own light.

All the inhabitants of the sea below the half-mile depth are very dark, almost black. But many of them have luminous spots on their sides, and some have large phosphorescent headlights. Others carry a luminous ball or sort of lantern hung on a long spine which projects forward over their mouths, and when little fishes come to nibble at it, they never return.

The greatest depth of the sea is over five miles, and fish

have been found three and four miles deep. Though the ones farthest down are black, those nearer the surface are of many colors. There are bright red fish that live among red seaweeds. Along the shore many of the fish are plain-colored like rocks or seaweeds. This is protective coloration. Those that are most brilliantly colored live about coral reefs and are very swift, so that they may avoid their enemies by speed or by creeping into clefts in coral formations.

## X. THE SEA OTTER

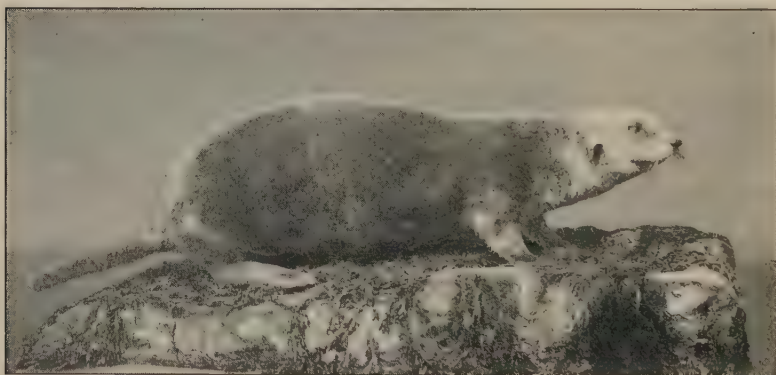
The sea otter is a large water animal with a human sort of face and long, soft fur of rich brown. It lives in the cold waters of the northern oceans. There was a time when it was very plentiful, so plentiful that about a century ago the Russians occupied the shores of Alaska, not because they wanted to live there, but because they coveted the beautiful fur of the sea otter, which is highly valuable.

Up to that time the sea otter bred in all the little bays from Alaska to central California or even farther south. Like so many other things of value, the species seemed to be inexhaustible, and the Russians were reckless in their destruction of it. But the Americans were even worse, for when we purchased Alaska in 1867 we failed to protect the sea otters of our enormous new domain, and in a few years the beautiful creatures were almost gone.

The natives along the shores of Alaska used to make their living largely by hunting the sea otter. You can judge how profitable this was from the fact that in the village church of Belkovski there was a communion service of solid gold paid for by sea-otter skins. There were pictures around the altar, too, painted by the best artists of Moscow, these canvases, like the communion service, having been bought with skins. The senior author himself saw them there, and the priest of the church told him the story of how they had been

obtained. Yet at that same time the people in this village and those about it were actually starving, because hunters from outside had shot all the sea otters. In another village that had once been rich, all the people were gathered together in an old warehouse with nothing to eat but fish. Although fish is good food, taken alone it is not satisfying, and these Alaskan natives, or Aleuts, were suffering a kind of starvation because they could get no other food.

When Dr. Jordan got back to the United States after that trip to the stricken villages in the far north, he drew up an



The sea otter, now one of the rarest of existing animals. Even mounted specimens are exceedingly scarce. This one in the United States National Museum at Washington is perhaps the finest specimen ever mounted.

order that the sea otter should not be caught in Alaska except with a spear. It was signed by Lyman J. Gage, at that time Secretary of the United States Treasury. This order was designed to save the sea otters that were left by preventing the greedy and unscrupulous skin hunters from shooting them. It also aimed to help the poor Alaskan natives by permitting them to hunt the sea otter in moderation.

During the years when the interesting creatures of the northern seas were being recklessly slaughtered, the noble-

men of Russia had overcoats of sea-otter fur, and Bismarck, the famous German statesman, once spoke in scorn of the poverty-stricken aristocrats of Poland who wore sea-otter overcoats and no shirts. But nowadays sea-otter coats are beyond the reach of most of the old aristocrats. In 1897, in Kamchatka, a skin hanging to dry on the outside of a hut was offered to the senior author for twelve hundred dollars in gold. If cured and ready for market in this country, it would no doubt have brought a great deal more than that.

## XI. THE FUR SEAL AND THE TRUE SEAL

Far up on two of the Pribilof Islands in Bering Sea lives the American species of fur seal. It has an under coat of dense, soft brown down, which is dyed a beautiful velvety black for commerce.

The fur seal is not really a seal. It is a sea lion, which is not a lion at all, but a big dark creature that is descended from bears, though how and when nobody knows. Through ages of living in water, the feet and legs of this type of bear changed into flippers, which are used for swimming. The shape of the head changed also, and so little by little there came to be what we know as sea lions. At least, this is what we may infer, because the anatomy of sea lion, fur seal, and walrus is much more like that of a bear than it is like the hair seal or harbor seal, to which group the name *seal* belongs. But the name *fur seal* has been used so long for these big beasts that now everybody accepts it. The fur seal is very much more at home in the water than upon the land. When he goes ashore, he travels awkwardly, running much as a cow would, its feet flapping like those of a little boy wearing his father's rubbers.

The fur seal is one of the most interesting of all creatures, either of the land or of the water. The autumn, winter,



and early spring he spends in the sea, but in May and June he lands on a certain chosen island, never elsewhere, and makes his home there throughout the summer. The young, or pups, are born in July, not long after the mother seals land. They learn to swim when they are six weeks old, and afterward spend most of their time in the water.

In October the winter storms of the north begin. Then the mothers and the young ones of the Alaskan or Pribilof Island herds move down through the Pacific Ocean. The mother seals go to the open sea far off the coast of California, while the young ones remain farther north. They never land anywhere, but swim about until it is time to start north again. The old males spend the winter off Sitka, and when the season breaks, they gather on the islands and await their consorts from the southern waters.

Through the killing of females at sea, the number of fur seals decreased rapidly. The United States government has always protected them on land by making it unlawful to kill any animals except males three years of age. But outside the three-mile limit — that is, beyond the coast waters over which our government has control — eager hunters shot great numbers of seals on their migrations or when going out to feed, females being killed as well as males. For each mother seal destroyed off the Alaska coast, one young one starved to death on the islands. Because of this greed on the part of hunters, the fur seal was fast disappearing. But in the year 1911 the United States government made an agreement with Canada, Japan, and Russia whereby pelagic sealing, or killing at sea, is internationally prohibited, and the wonderful breed of animals is saved. Since then the American and Japanese herds have increased rapidly, but those on the Russian islands have been robbed by their own guardians. Those who would know more of the life of these interesting beasts may read Dr. Jordan's *Story of Matka*.



Fur seals drowsing among the rocks of the Pribilof Islands.

Species of the true seal, or hair seal, live along the eastern coast of North America, off Nova Scotia and Labrador, and off most coasts everywhere. True seals do not have long flippers, like the fur seal and the sea lion, but they have short toes, and their hind legs are so bound back that they cannot walk on land. They draw themselves along by their forefeet, dragging their hind feet behind them. When they see anyone coming, they seem to melt away, so speedily and softly do they get themselves into the sea, where they are at home and feel safe.

There are many kinds of true seals in different parts of the world, but the Labrador species is the best known. All true seals are covered with thick yellowish fur, not nearly so handsome as that of the fur seal, but their skins are used for many purposes. If you can get into an old, old attic, one that contains various things left over from your great-grandfather's time, you may find a trunk covered with the fur of the true seal, which was much used for that purpose a century ago.

In the far north, both in Greenland and Alaska, lives the walrus. He is like a huge sea lion in many ways, but has

no fur at all. His skin is thick and rough. Two of his upper teeth are far longer than those of any other animal except the elephant, and they are made of white, fine-grained ivory. In the early days, when men made trips far to the north, they brought back walrus teeth as the most remarkable and most valuable of their discoveries. You may read in Longfellow's poem of the old sea-captain, Othere of Helgoland :

Othere, the old sea-captain  
Who dwelt in Helgoland,  
To King Alfred, Lover of Truth,  
Brought a snow-white walrus tooth  
Which he held in his brown right hand.

## XII. CONSERVATION OF THE FISHES

These are just a few of the creatures that live in the water, under the ripples of the lakes and rivers and among the waves of the sea. All of them are interesting, and excepting the few species that are destructive, they should be protected and preserved. Every person who fishes can do his part toward conserving the fish, by catching only the number he needs instead of taking them from the water ruthlessly and leaving them to die on the shore. The meanest creature who infests the mountains is the man who slaughters the beautiful trout and leaves them to dry up on the stream banks, destroying them for no purpose except just for the satisfaction of catching them — and very often do we hear of him. During the fishing season, until recent years, the papers used to tell of the exploits of A—— and his cronies, who caught four hundred and fifty golden trout in one morning; of B——, who sent a box of three hundred and eighty home to his club; of C——, who was equally ignorant and greedy in wasting beautiful life. Trout hogs, we call them, but in doing so we owe an apology to the comparatively well-behaved swine.

The Indians were too wise and too much in harmony with nature to be guilty of such waste of beautiful life. They hunted and fished in order to supply their needs, and when their needs were satisfied, they stopped. Some tribes had strict laws against unnecessary destruction of animal life, and punishment was meted out to whoever disobeyed them. Among the Chinooks along the Columbia River, where each autumn the salmon by millions hurry upstream to spawn, there is "the salmon taboo" and this is the story that the old men and women tell about the origin of that law.

When Coyote came to the shore of the Columbia, he entered into partnership with Lizard and Bat to engage in the fishing business. They made a net by splitting the roots of a spruce and knotting the strands together. Plenty of driftwood provided the necessary floats for the top of the net; and for sinkers they had stones.

With the net completed, Coyote paddled out with one end, Bat and Lizard holding the inshore end. They drew the net and caught but one salmon. Coyote was enraged at this ill-luck and protested to Sahalee Tyee, who brings good or bad luck to fishers. The answer to his protest came: "A fool ought to know that one must fish on the ebb tide."

"It is enough; I have heard," said Coyote.

The next day they tried again when the tide was ebbing, and they caught two salmon. Again the protest, and the answer from Sahalee Tyee was that on the previous day they had cut the salmon into blocks. "The only way to cut the salmon is to separate the backbone from the flesh, leaving the belly whole. Unless you do this, the salmon will be ashamed and will not come into the river."

Another trial was made on the third day, and three salmon were caught. Again Coyote protested. He was told that on the previous day they had thrown the salmon upon the shore, trampled on the fish, and filled its eyes with sand; and this too would make the salmon ashamed.



Four salmon were caught the following day, but still Coyote was not satisfied. Then he was told that they had cooked all the salmon the previous day and had left half of one uneaten. Thereafter they must cook only as much as they could eat at one sitting, because unless they ate all the salmon they cooked, the fish would be ashamed and would not come into the river.

"The salmon taboo," the custom requiring that they must cook no more fish than they could eat, and catch no more than they intended to cook, existed all along the Columbia River among the Indians who lived there. Dr. Franz Boas says that one of the first missionaries who went to that region, about 1840, was invited one day to a salmon feast. When the guests were assembled, the doors were closed, and no one was permitted to go out of the place until the last morsel of salmon had been eaten. The reason for this was the same as the one that Coyote had heard. The salmon would be ashamed and would not come into the river unless every bit of the fish that had been prepared was eaten.

It would be a good thing if more people today felt as many did far back in the time when Good Queen Bess was ruling in Merrie England and a poet wrote these words:

Enjoy thy stream, O harmless fische,  
And when the angler for his dysshe  
Through gluttony's rite sin  
Attempts, the wretch, to pull thee out,  
God give thee strength, O gentyle trout,  
To pull the rascal ynné.

## CHAPTER FOURTEEN

### "GOD'S FIRST TEMPLES"

#### I. THE GIANT TREES

IN the state of California, on the west flank of the Sierra Nevada, grow the biggest of big trees. They are called sequoias, and groves of them are found about halfway up the slopes. Of these groves, the smallest is in El Dorado County, and the largest in the county of Tulare. The giant sequoia is a sort of cedar, with delicate, brittle wood of a pink color, short leaves, and small cones scarcely more than an inch long.

The sequoia is sturdily built and grows rapidly when young, but very slowly as it gets older. Not many of these Big Trees have been cut, and if our people were wise they would never allow another one to be turned into lumber. In Converse Basin in Tulare County, however, a beautiful grove of these glorious giants was destroyed by lumbermen, who had hard work making away with them, for the trees were so large that some of them reached a height of two hundred feet and a diameter of thirty feet at the base. The only way the men could get them down was to tear them to pieces with dynamite and then wreck them still further before they could saw them into slabs. The wood was used to make chalk boxes and the like — wood that had taken five thousand years to grow!

The great trees of the Sierras are the oldest living things. We learn their age by counting the rings the years have marked upon their wood. Five to six thousand rings have been counted on cross sections of some of these shafts, so we know they were vigorous saplings when the pyramids were built along the Nile, and splendid young forest giants at the beginning of the Christian era. John Muir calls the sequoia "nature's forest masterpiece," for notwithstanding



Giant Sequoia, the tree called General Sherman, said to be the largest tree in the world and perhaps 6000 years old; in the Sequoia National Park in the Sierra Nevada Mountains of California.

the enormous age of these trees they are not in the least dead looking, but are still growing, green and full of vigor.

In the great sequoia forests there are seldom any young sequoia trees, and the reason for this is plain enough. Foliage has been falling from the big trees for forty or fifty centuries until the ground is covered two or three feet deep with dead leaves, and the seeds cannot sprout at all, except where a stream runs through the forest, as is the case with the General Grant Forest in Tulare County. There we find many young trees, for as the dead leaves are washed away, the seeds have a chance to sprout along the banks of the brook.

The oldest known grove of sequoias, and a very beautiful one, is in the county of Calaveras, California. It is still in private ownership, although strong efforts have been made to induce the state or nation to buy it. There is a large grove in the county of Mariposa, which belongs to the United States government. In this grove there is one tree which at some time or other was partly burned, and a stagecoach passes through it in a sort of tunnel cut out between the forks of the roots.

In the mountains of the Coast Range of California is another species of big tree, also a sequoia. It is called *Sequoia sempervirens*, which means ever-green. It is commonly known as the redwood, because of the color of its wood. This wood is brittle and easily marred, but it burns slowly and so is valuable for building purposes. The leaves of the redwood are larger than those of the Big Tree, but its little cones are about the same length. The bark is thinner, and the tree is much more slender for its size. The largest redwoods are sometimes even taller than the Big Trees, twenty feet through at the base, and are about two thousand years old.

Perhaps the most noted of the beautiful groves of redwoods in the Coast Range is Muir Woods, a short distance north of San Francisco. During one of his rambles in these





Among the redwoods, in the California State Redwood Park, in the mountains of Santa Cruz County.

mountains, John Muir came upon a grove of mighty trees in a basin hidden among the hills of Marin County. Wherever he went, he tried to teach people to appreciate this forest as a joy-giving, health-giving asset. After many years, as a result of his efforts, it was presented by a nature lover, William Kent, to the state of California and set aside as a public park.

Another grove of giant sequoias, as beautiful as the Muir Woods, for its greatest trees are even larger, is that of the State Redwood Park — Big Basin, as it is usually called — a broad valley in the county of Santa Cruz. Like the Muir Woods, this grove is a public park belonging to the state of California, chiefly as a result of the untiring efforts of Mr. Andrew P. Hill, who is known throughout California as "the Father of the Big Basin." Mr. Hill devoted

years of persistent labor to the task of arousing interest in the redwoods of the Big Basin, never once swerving from his determination that California should buy the grove. After many discouragements he succeeded, and before he died, he had the satisfaction of knowing that the trees he loved so well would be preserved in a public park.

There is a worn redwood standing in the Santa Clara Valley away from the forest, by the side of a stream which must have brought the seed from the mountains. This has long been known as the Palo Alto, or tall tree. It stands on a corner of the campus of Stanford University, which is sometimes called the University of the Tall Tree.

The redwood is the only one of our evergreen trees which does not die when it is cut down. It has a curious vitality, and new trees spring up from its roots, or even from its stump. In regions where the redwoods have been cut or burned off, if the soil was not destroyed by the fire, we often see several trees a foot or two in diameter in a ring surrounding an old stump. The stump decays but the root does not die. It is hard to kill a redwood by fire, or in any other way, because of the young shoots that spring up. Some of the Australian eucalyptus trees have this same characteristic; but among the evergreens, except the coast redwood, once a tree is cut down, stump and roots die together.

## II. THE PINES

The great forests of the Sierras have several kinds of pines, and one of these, the sugar pine, is not only the largest pine in the world, but the tallest, straightest, and finest. It is a sturdy tree, sometimes reaching a diameter of ten feet at the base. The sugar pine makes the best masts and the best flagpoles of any tree in the world.

James Douglas, a famous botanist, was the first to write about the sugar pine, and in describing it he said, "It is doubt-

less the noblest of all vegetables." He did not mean to compare it with a vegetable to eat, like an onion or a head of cabbage. He meant that the sugar pine is the noblest member of the great plant kingdom, to which all trees belong. But James Douglas had never seen any redwoods or sequoias.

The sugar pine is far smaller than the Big Trees, or the coast redwoods, but its fine, upstanding trunk makes it seem in some ways a nobler growth than any of these. It has long cones, sometimes a foot and a half in length, beside which the conelets of the Big Trees look very small.

Along with the sugar pine of the high Sierras grows the yellow pine, not quite so large or so fine but much more abundant. You may know the yellow pine when you see it because its leaves are very long and dark green, while those of the sugar pine are rather short. The yellow pine has cones only about six or eight inches long, a third as big as those of its cousin, the sugar pine.

The Digger pine, which grows lower on the hills, gets its name from the Digger Indians, who ate its seeds. This pine is worthless for timber. You will know the Digger pine because it grows lower down on the mountains than other pines of the Sierras, and its leaves are very long and bluish colored instead of deep green.

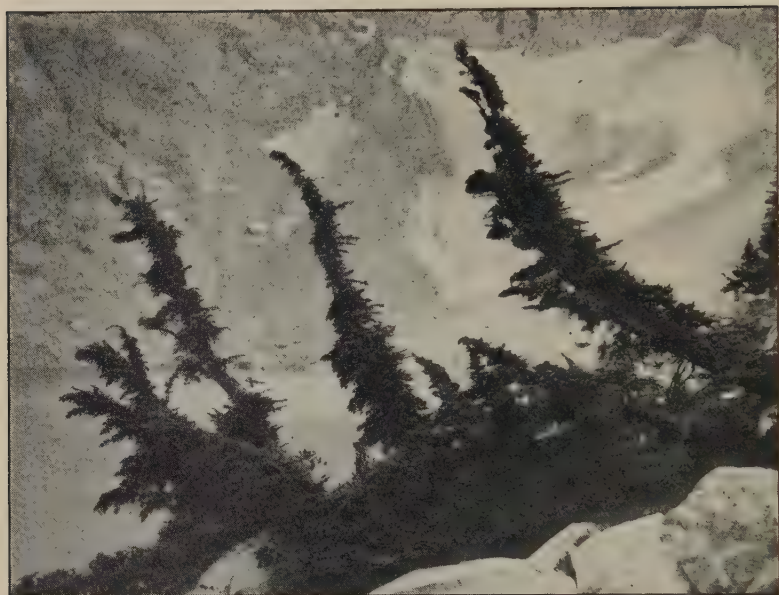
Here and there in the western mountains other pines are found. High up near the snow line is the tamarack pine, with very short leaves and smooth bark.

Around Monterey Bay, and for a few miles southward down the coast, there is a pine with rather slender, deep green leaves, which never reaches a large size and probably never lives to be more than one hundred years of age. This is the Monterey pine, and the curious thing about it is that it is unlike any other American pine and does not grow out of sight of the sea in its natural state, although it thrives almost anywhere when transplanted. To find another pine of this sort one has to go to Japan, where along the coast there are



A grove of mountain hemlocks growing near the timber line in the Shadow Lake region of the Sierras in California. This is the tree that John Muir has called the finest of all the conifers. In protected canyons, such as this, the foliage is very thick and the branches grow close to the ground. Grouse are fond of hiding in these retreats and sometimes large numbers may be passed unnoticed by an observer.





Western junipers growing above the timber line near Iceberg Lake, on the slopes of the Minarets in the Sierra Nevada Mountains of California. Note the contorted stems whose picturesque shapes are due to their being loaded down during the heavy winter snows.

two species, one of them almost exactly like the Monterey pine and the other not very different. It does not take a very good guesser to infer that the seed of the Monterey pine was at some time or other carried across the water, perhaps by the Japan Current.

Like the Digger pine, the Monterey pine is worthless for timber. Beams made of it do not last long, but in early days nothing else was available in the region where it grows. Monterey pine was necessarily used in making Mission San Antonio de Padua, one of the most charming of the Franciscan foundations, though its roof fell while the building was still young, not more than fifty years after it was built.

The forests from Maine to Minnesota contain spruce,

cedar, pine, fir, and larch. But the principal tree of this region is the common white pine, which, although small as compared with the giants of the Sierras and the western woods, is one of the most useful of all trees. It is largely used as a building material, and in the eastern part of America most of the houses were until recently built of its wood. It grows as far south as Georgia and Alabama and as far west as Illinois and Iowa. In the Great Lakes region, however, it reaches its best development, attaining a height of a hundred and fifty feet and a diameter of six feet.

The white pine has soft, feathery, bluish-green foliage, needles in bundles of five, and thin, smooth, grayish-green bark. Its wood is close-grained and durable, not likely to warp or check, light in weight, yet very strong, soft and easy to work, all of which makes it valuable for building purposes. It is a beautiful tree and is much planted for ornamental effects, many city streets, gardens, and parks being graced by its feathery branches.

### III. CYPRESS, FIR, AND SPRUCE

Near the little Bay of Carmelo there is a tree unlike any other growing wild in California. This is the Monterey cypress, and evidently the seed was brought to the California shore by ocean currents from some place far distant, perhaps from South America.

The Monterey cypress grows naturally on two headlands close to the sea, where it is twisted and bent into all sorts of fantastic shapes by the strong winds. Some of these trees are very old, and their gnarled limbs and bent trunks suggest that they have grown up in agony. There is not one of these cypress trees growing wild which is more than a few rods from the ocean. When the seeds are planted, they thrive anywhere, and under cultivation they are no longer gnarled or stunted. They make fine hedges or, if allowed

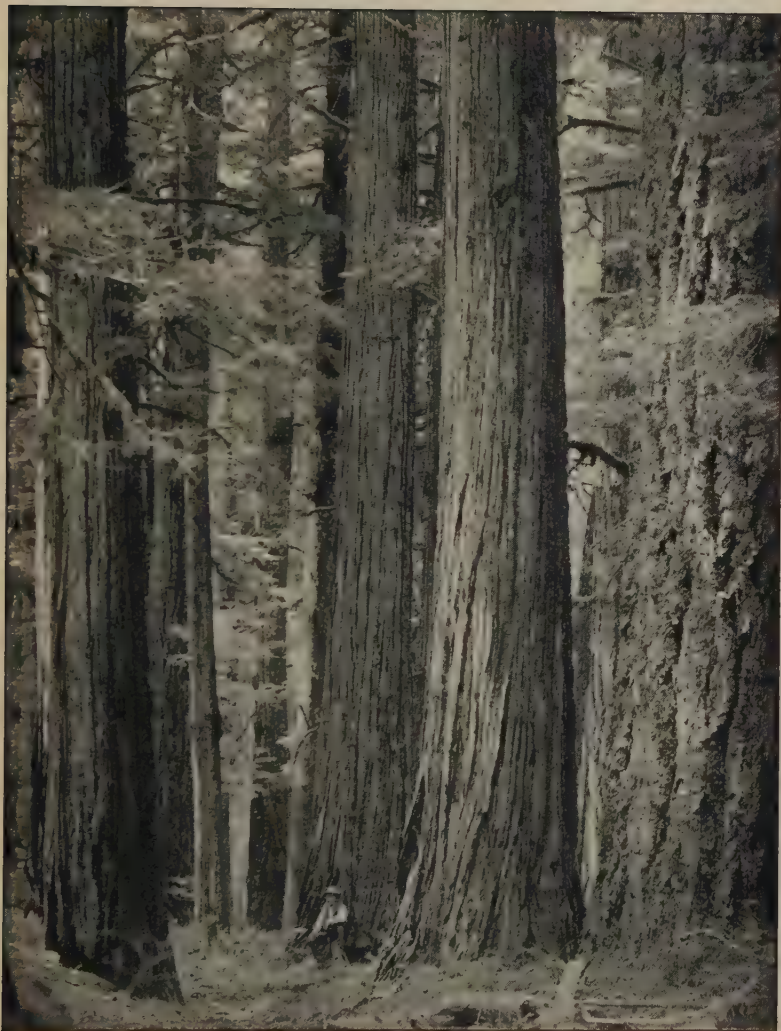
to grow without being trimmed, good windbreaks. They are planted all over California and also in southern Australia, where the climate is very much like that of California.

The vast forests of Washington, Oregon, and British Columbia are composed mostly of spruce and fir, the so-called Oregon pine or Douglas fir being a species of spruce. Also in this northwestern region, as well as in the mountains of California, are found the western hemlock, an evergreen with soft, lustrous foliage, the incense cedar with close-set leaves, and the fantastic junipers, with fragrant branches and berries. Juniper berries, as they ripen, become bright red or copper hued, and in the autumn make vivid patches of color in the woods where they grow.

The great timber regions of the Northwest are among the most extensive in North America, and they stretch for hundreds of miles west of the Cascade Range. Consequently this has become one of the most noted of all lumbering districts, its timber going to make houses and ships throughout the world.

The forests of the Northwest, and the industries growing out of them, have contributed greatly to the growth of Portland, Seattle, Spokane, and Tacoma, the largest cities of Oregon and Washington. In the beginning these cities were founded because farmers in the fertile Washington and Oregon valleys required a market for their produce. But as the industries of the Northwest developed, the lumbering in the forests greatly increased the growth of these cities. Portland and Seattle, both with fine harbors, are now, because of their shipping, among the great cities of the United States, and the vast quantities of lumber from the spruce and fir woods are one of the chief commodities that go forth from their wharves.

The trees are very large and very close together in the great forests of the Northwest, and there is probably more timber there to the square mile than in any other part of the



Port Orford cedars and Douglas spruce (at the right) in the Coos Bay region of Oregon.



world. Spruce and fir are mingled with other evergreens in California, but as you go northward the pines and redwoods gradually disappear and the spruce takes their place.

Everyone who loves trees ought to know the difference between a fir and a spruce, for the two kinds of trees are very much alike. In spruce trees the cones all droop, being turned downward, and the leaves cover every side of the stem, so that when you look at a spray of spruce the leaves on the under side are out of sight. But on a fir all the leaves turn toward the upper side, and the cones always point straight upward. Here is a jingle that may help you to remember these facts :

F is for fir;  
It looks toward the firmament.  
S is for spruce;  
It sags toward the sediment.

#### IV. MAPLES AND OTHER TREES

Scattered throughout the eastern part of our country, we find maple trees. There are several kinds of maples in the United States, one of the most beautiful being the red maple. This tree grows mainly in New England and southward along the Allegheny Mountains. In autumn its leaves turn brilliant scarlet. Another species, the silver maple, is like the red maple, but in autumn its leaves turn yellow. The silver maple is characteristic of the prairie country, where it is often planted for shade in the cities, because it is one of the few trees that will thrive in the soft black soil of the plains.

The sugar maple is the pride of the family. It has beautiful foliage, and it grows to a much larger size than any of the other maples. In the sugar maple the sap flows abundantly and is so sweet that it may be concentrated into the most delicious of all forms of sugar. Sugar maples are especially abundant in Vermont. In fact, Vermont is sometimes called Maple Sugar Land, and the name is very appropriate,

because it leads all the other states in the production of maple sugar.

The method of taking maple sap is very simple. Just as soon as the frost is out of the ground, the sap begins to run. A hole is then bored into the tree, and the sap is made to flow



Gathering the sap in a Vermont sugar bush. The buckets in which the sap collects are hanging on some of the larger trees.

through a spout into a bucket. In the height of the season, the flow is so rapid that a good-sized bucket may be filled from one tree in a day. After the sap is collected, it is put into large kettles and boiled down to a thick sirup, which crystallizes into sugar. Ohio, Michigan, Indiana, and New York have plenty of maple trees, but the sugar is not quite so good as that of Vermont, because the farther south you go, the earlier the leaves come out, and just as soon as the leaves begin to form, the sap turns bitter.

The Indians used maple sugar before the whites came to America. They tell a curious story about the discovery of it.

Once a squaw of the Mohawk tribe started to a brook to get some water in which to cook the venison for her husband's supper. She heard other women chatting in the wigwams as she went through the woods and wished that she might spend the day with them instead of trudging far for water. It was springtime, and the sap in all the trees was flowing freely. The Indians, who knew all about the sweet water, had tapped a maple so that they might have some of it to drink. The squaw happened to pass the tree and saw it dripping.

"Why go to the brook when there is water here?" she thought. So she set her kettle under the tree and went back to the women.

Several hours passed. It was pleasant in the village gossiping with the other women and the squaw forgot all about the kettle under the tree. The sun went down and it was almost time for her lord to return from the game trail before she thought of it again. Then hurrying to the maple, she found her kettle full of water. Hastening home with it, she lighted a fire and set the venison to boil.

But again she heard the squaws chatting and again she joined them; and when she finally came home to see about the venison, the meat was scorched and dry. Indian braves are very terrible when their food is spoiled, and knowing that her husband would beat her for her carelessness, she ran into the woods to hide. She stayed there until the stars came out and the owls hooted like evil spirits among the trees.

The black night in the lonely forest terrified her even more than the thought of a beating, so she started back to the wigwam. As she neared the tepee, she heard from within grunts that sounded as if somebody were having a good time. Peeping in, she saw a sight that amazed her. Her husband was squatting on the ground beside the kettle, eating greedily of the scorched venison meat, which he found more delicious than any he had ever tasted, for over it was spread a



A magnificent specimen of the American elm, the pride of the streets of many New England towns.

sweet brown substance, sugar left by the water that had boiled away. He was very much pleased with his wife for having prepared such an excellent dish for him, and praised her highly. So the gossiping squaw was not beaten, but instead was honored by her tribe because she had brought to them knowledge of how to make their food more palatable. Thus they came to know that the sap could be turned into sugar, and after that the venison of the Mohawk feasts was always cooked in maple water.

Many other fine trees abound in the regions where the maples grow. Most stately of these is the elm, with urn-shaped form and fine green foliage, the pride of New Eng-



land. Along many of the eastern rivers, and some of those of the West also, is the sycamore, with gray-white bark and gracefully shaped leaves of a rich deep green. In the woods throughout the eastern and central states grows the birch, the tree that furnished the Indians with bark for covering their canoes, and around which cluster countless stories of the wigwam days. Then, too, there are the chestnuts, the butternuts, and hemlocks of the eastern forests, and the basswood, which in spring sends out clusters of delicate, cream-colored blossoms. There is the buckeye that grows in the Middle West, from which Ohio came to be called the Buckeye State. In the northern woods, we find the dogwood, flaunting white leaves around its blossoms in April and May; the sour-gum, with splendid red foliage in the fall; the sweet-gum, that becomes gorgeous with the first frosts; and a long series of different kinds of oaks. Another fine tree is the beech, growing usually beside maples. The little three-cornered nuts of the beech are delicious and furnish food for thousands of hogs in the various regions where this tree is abundant. Thoreau says that no other tree has so fine an ankle or instep as the beech.

## V. FOREST PROTECTION

"The forests of America, however slighted by man, must have been a great delight to God, for they were the best He ever planted."

It was John Muir, scientist and nature lover, who wrote these words, and never did anyone write more truthfully, for the forests of America *were* the best that ever grew. Their trees were taller and more splendid of girth than any that have grown in the Old World, and their range of variety was greater. But our people have allowed so many forests to be recklessly destroyed without insisting upon replanting that the number of trees left standing now is pitifully small as compared with that of fifty years ago. Much of this destruction

might have been avoided by the exercise of a little common sense.

It has been a habit of many lumbermen to get rid of brush by setting it on fire, and in destroying the brush they burn up the layers of dead leaves which protect the soil. Tracts burned over in this wanton manner are left with great bare rocks on the surface and will never, in all probability, be covered with trees again.

In 1908 and later, as a member of the International Fish Commission, Dr. Jordan crossed the continent from New Brunswick to Alaska three times. Traveling now on one side of the boundary between the United States and Canada, and now on the other, it seemed to him pitiful to see the waste of trees and waste of land occasioned by the burning of trees. All the way from New Brunswick to Minnesota there were wide stretches of fire-devastated country, in spite of the efforts of both governments to have the forests harvested instead of murdered.

It has been necessary to cut down many trees for building purposes and to clear land for agriculture. Thousands of acres of woodland have gone in this way through necessity, and much more will have to go. But forests of evergreen trees, especially pines, usually cover sandy or rocky soil that is not well fitted for farming. When lumbermen harvest them for timber, they should not be permitted to burn off the underbrush and, in burning it, partially or wholly destroy the soil. Extensive woodland tracts, in general, should not be sold to individuals. They should be held by the government, and lumbering should be done in such a way as to leave the beginning of a new forest. As an American editor expresses it, "Forests should not be left to the hazard of private greed, but should be protected by the people for the people."

Nature has been so generous to our country that people have forgotten that there is an end to all good things. The



A ranger and a forest guard on fire-patrol duty, making an observation for forest fires from Mt. Silcox Lookout Station, Cabinet National Forest, Montana.

man who is a true patriot will not wreck or mar any feature of his land for present gain to himself. The lumberman who makes no attempt to leave behind the beginning of a new tree growth is not a good American.

Of late years the United States government has established national parks and forest reserves, especially in the western states. And if people are mindful of the groves that have not been destroyed, we shall yet have some wealth of trees to leave to those who come after us, although we cannot give them as splendid a legacy as we might have passed on if the lumbermen had felt as Joyce Kilmer did :

I know that I shall never see  
A poem splendid as a tree ;

A tree whose hungry mouth is prest  
Against the earth's sweet-flowing breast ;

A tree that looks to God all day  
And lifts her leafy head to pray ;

A tree that may in summer wear  
A nest of robins in her hair ;

Upon whose bosom snow has lain,  
Who intimately lives with rain.

Poems are made by fools like me  
But only God can make a tree.

We have come to the end of our story of America's geographical high lights. In one book it has not been possible to tell even a fraction of what there is to learn about the things we have mentioned, but we hope we have told you enough to make you want to know your country better, to arouse in you a desire to see the wonders that are hidden among her "woods and templed hills." Every American should know the mountains, gorges, and groves of our beautiful land. As you look up into branches of trees that were forest monarchs when Rome was young, if you have a soul that responds to beauty, you are sure to feel as John Muir did when he said, "I tread the crust of the earth in adoration."



## NATIONAL PARKS

The nineteen National Parks, with a total area of 11,387 square miles, include scenic features of great magnificence and wide variety. They are completely conserved in a condition of primitive nature.

PARKS IN ORDER OF CREATION	LOCATION	AREA IN SQUARE MILES	DISTINCTIVE CHARACTERISTICS
Hot Springs 1832	Arkansas	1 $\frac{1}{2}$	46 hot springs possessing remarkable properties which alleviate and often cure rheumatic and other affections.
Yellowstone 1872	Wyoming	3348	More geysers than in all the rest of the world together; boiling springs; petrified forests; canyons remarkable for gorgeous coloring; vast wilderness; greatest wild bird and animal preserve in the world.
Sequoia 1890	California	252	Hundreds of sequoias over 10 ft. in diameter, and many 25 to 36 ft. in diameter; startling precipices and towering mountain ranges.
Yosemite 1890	California	1125	Immense granite wilderness; the Yosemite Valley acknowledged the most beautiful in existence; many waterfalls of extraordinary height; great forests; hundreds of lakes.
General Grant 1890	California	4	Created to preserve the famous General Grant Tree, 35 ft. in diameter, and the splendid forest which surrounds it.
Mount Rainier 1899	Washington	324	28 glaciers, some of large size; 48 sq. mi. of glacier, 50 to 500 ft. thick; wonderful wild flower fields, surrounded by enormous trees.
Crater Lake 1902	Oregon	249	Lake of extraordinary depth and color, filling crater of an old volcano; 6 miles in diameter; brilliantly colored lava sides rising 1000 to 2000 ft. above the surface.
Wind Cave 1903	South Dakota	17	Limestone cavern having many miles of galleries and numerous chambers containing peculiar formations.
Platt 1904	Oklahoma	1 $\frac{1}{3}$	Many sulphur and other springs which possess high medicinal value.
Sullys Hill 1904	North Dakota	1 $\frac{1}{2}$	An important wild animal reservation.
Mesa Verde 1906	Colorado	77	Most notable and best preserved cliff dwellings in the United States, perhaps in the world.

PARKS IN ORDER OF CREATION	LOCATION	AREA IN SQUARE MILES	DISTINCTIVE CHARACTERISTICS
Glacier 1910	Montana	1534	Rugged mountain region of unsurpassed beauty; 250 glacier-fed lakes; 60 small glaciers; precipices thousands of feet deep; next to the Yellowstone, our most populated wild animal reserve.
Rocky Mountain 1915	Colorado	397½	The heart of the granite Rockies, with peaks from 11,000 to 14,255 ft. in altitude; remarkable records of the glacial period.
Hawaii 1916	Hawaii	186	Kilauea and Mauna Loa on Hawaii, and Haleakalā on Maui; includes the world-famous "Lake of Everlasting Fire."
Lassen Volcanic 1916	California	124	Only active volcano in the United States proper; Lassen Peak 10,465 ft.; Cinder Cone 6879 ft.; hot springs; mud geysers.
Mount McKinley 1917	Alaska	2645	The heart of the Great Alaskan Range with Mt. McKinley rising 20,700 ft. seen from an altitude of 3000 ft.; colossal glaciers; caribou and mountain sheep in large numbers.
Grand Canyon 1919	Arizona	958	The greatest example of erosion, and no doubt the spectacle nearest sublimity in all the world.
Lafayette 1919	Maine	23	Ancient granite mountains on Mt. Desert Island, remarkable for their beauty, forests, and history.
Zion 1919	Utah	120	"The Rainbow of the Desert"; a gorge cut 2000 ft. down through the White Cliff and the Vermilion Cliff; magnificently carved by erosion.

## NATIONAL MONUMENTS

There are fifty-five National Monuments created by Presidential proclamation to conserve objects and areas of historic or scientific importance. They are usually, but not necessarily, small. They include many distinguished ruins of prehistoric civilization and the Spanish occupation, and some of the geologic examples are most remarkable. The Rainbow Bridge is one of the world's most imposing spectacles.

MONUMENTS IN ORDER OF CREATION	LOCATION	AREA IN ACRES	DISTINCTIVE CHARACTERISTICS
Devils Tower 1906	Wyoming	1,152	Basaltic core of ancient volcano rising 1200 ft. from level plain.
Montezuma Castle 1906	Arizona	160	Large prehistoric cliff dwelling in niche in vertical rock.
El Morro 1906	New Mexico	240	Castle-shaped rock on which early Spanish explorers carved inscriptions.
Petrified Forest 1906	Arizona	25,625	Highly colored petrified tree trunks.
Chaco Canyon 1907	New Mexico	20,625	Prehistoric cliff dwellings and communal houses.
Gila Cliff Dwellings 1907	New Mexico	160	Prehistoric cliff dwellings near Roosevelt Dam.
Tonto 1907	Arizona	640	Prehistoric cliff dwellings.
Muir Woods 1908	California	426	Fine grove of coast redwoods near San Francisco.
Pinnacles 1908	California	2,642	Spire-like rocks, 600 to 1000 ft. high; also caves.
Jewel Cave 1908	South Dakota	1,280	Limestone cave of great beauty; richly colored formations.
Natural Bridges 1908	Utah	2,740	Three rock bridges of enormous size; fine examples of erosion.
Lewis and Clark Cavern, 1908	Montana	160	Limestone cave on route of Lewis and Clark expedition.
Tumacacori 1908	Arizona	10	Ruin of Franciscan mission of seventeenth century.
Wheeler 1908	Colorado	300	Fantastically eroded volcanic area.
Mount Olympus 1909	Washington	299,370	Lofty mountain region, home of the Olympus elk.
Navajo 1909	Arizona	360	Prehistoric cliff dwellings in good preservation.
Oregon Caves 1909	Oregon	480	Large limestone caves of unknown extent.

MONUMENTS IN ORDER OF CREATION	LOCATION	AREA IN ACRES	DISTINCTIVE CHARACTERISTICS
Shoshone Cavern 1909	Wyoming	210	Limestone cave near Cody entrance to Yellowstone.
Gran Quivira 1909	New Mexico	560	Ruins of early Spanish mission; historical interest.
Sitka 1909	Alaska	57	Scene of massacre of Russians by Indians; totem poles.
Rainbow Bridge 1910	Utah	160	One of the most majestic spectacles in the world; marvelous example of erosion.
Big Hole Battle Field, 1910	Montana	5	Where Nez Percé Indians were defeated in 1877.
Colorado 1911	Colorado	13,883	Remarkable examples of erosion; lofty monoliths.
Devil's Postpile 1911	California	800	Spectacular mass of basaltic columns.
Cabrillo 1913	California	1	Headland where Pacific coast was first sighted, 1542.
Papago Saguaro 1914	Arizona	1,940	Varied desert flora.
Dinosaur 1915	Utah	80	Extraordinary deposits of fossil animal life.
Walnut Canyon 1915	Arizona	960	Many prehistoric cliff dwellings.
Bandelier 1916	New Mexico	22,075	Cliff dwellings, hollowed in soft volcanic rock; many pueblos.
Capulin Mountain 1916	New Mexico	681	A perfect cinder cone.
Old Kasaan 1916	Alaska	38	Abandoned Indian village with good totem poles.
Verendrye 1917	North Dakota	253	Crowhigh Butte, from which white men first saw country west of Missouri River.
Casa Grande 1918	Arizona	480	Remarkable prehistoric ruin.
Katmai 1918	Alaska	1,088,000	Recently exploded volcano of unusual scenic and scientific interest; Valley of Ten Thousand Smokes.
Scotts Bluff 1919	Nebraska	2,053	Landmark of early transcontinental travel.
Yucca House 1919	Colorado	10	Ruin of prehistoric pueblo.
Lehman Caves 1922	Nevada	593	Limestone caves.



MONUMENTS IN ORDER OF CREATION	LOCATION	AREA IN ACRES	DISTINCTIVE CHARACTERISTICS
Timpanogos Cave 1922	Utah	250	Limestone cave.
Fossil Cycad 1922	South Dakota	320	Rich deposits of plant fossils.
Aztec Ruin 1923	New Mexico	5	Restored prehistoric pueblo of 500 rooms.
Mound City Group 1923	Ohio	57	Prehistoric Indian Mounds within Camp Sherman Military Reserve.
Hovenweep 1923	Utah-Colorado	286	Prehistoric towers, pueblos, and cliff dwellings.
Pipe Spring 1923	Arizona	40	Refuge against Indians; important early Mormon station; only pure water for miles.
Bryce Canyon 1923	Utah	7,000	Niche in the Pink Cliff filled with intricately eroded minarets gorgeously colored.
Carlsbad Cavern 1923	Utah	719	Entrance to the greatest caves in the world.
Craters of the Moon, 1924	Idaho	24,960	Bad Lands and volcanic craters.
Wupatki 1924	Arizona	2,334	Prehistoric ruins.
Chicahua 1924	Arizona	4,480	Striking sandstone pinnacles.
Fort Wood 1924	New York	2½	Enclosing the Statue of Liberty.
Castle Pinckney 1924	South Carolina	3½	Historic fort.
Fort Pulaski 1924	Georgia	20	Historic fort.
Fort Marion 1924	Florida	18	Historic fort.
Fort Matanzas 1924	Florida	1	Historic fort.
Meriwether Lewis 1925	Tennessee	50	Historic site.
Glacier Bay 1925	Alaska		Muir Glacier and others converging into the sea.
Lava Bed 1925	California	46,967	A volcanic region containing many interesting caves with Indian inscriptions.

## PRONUNCIATION LIST

The markings of the letters are in accordance with Webster's *New International Dictionary*.

Acoma ä'kō-mä	Congaree kōng-gā-rē'
Adirondack äd-ī-rōn'dāk	Cordillera kōr-dīl-yā'ra
Aibemarle äl'bē-märl	Duluth dōō-lōōth'
Aleutian â-lū'shän	Elsinore ěl-sī-nōr'
Algonquin äl-gōn'kīn	Esmeralda ěz-mē-räl'dä
Allegheny äl'ĕ-gā-nī	Estes ěs'tiz
Apache â-pä'chā	Gallatin gäl'ā-tīn
Apalachicola äp-â-läch'ī-kō'lā	Geode jē'ōd
Astoria äs-tō'rī-â	Gila hē'lā
Avalon äv'ā-lōn	Gloucester glōs'tēr
Aztec äz'tĕk	Guadeloupe gō-dē-lōōp'
Bering bē'rīng	Haleakalā hä'lā-ä'kā-lā'
Berkeley būrk'li	Halemaumau hä-lē-mou'mou
Bogoslof bō'gōs-lōf	Hawaii hä-wī'ē
Bolinas bō-lē'näs	Honeoye hūn'ē-oi
Bonneville bōn'vĕl	Illouette īl-ōō-ĕt'
Borgne bōrn'y'	Iroquois īr-ō-kwoi'
Bozeman bōz'män	Isleta ěs-lā'tā
Brazos brā'zōs	Itasca ī-tās'kā
Butte būt	Iztaccihuatl ěs-täk-sē'hwät'l
Cajon kā-hōn'	Juan de Fuca hwän' dā fōō'kā
Canadice kăn'ä-dīce	Juneau jōō-nō'
Canandaigua kăn-än-dā'gwā	Katahdin kā-tā'dīn
Casa Grande kă'sä grän'dā	Katmai kăt'mī
Cayuga kâ-yōō'gā	Kauai kā-ōō-ä'ē
Chapala chā-pā'lā	Kaweah kâ-wē'ā
Chapultepec chā-pōōl-tā-pĕk'	Kennebec kĕn-ĕ-bĕk'
Chattahoochee chăt-â-hōō'chĕ	Keokuk kē'ō-kūk
Cherokee chĕr-ō-kē'	Keweenaw kē'wē-nō
Chiapas chĕ-ä'päs	Kilauea kē-lou-ā'ä
Chichen-itza chĭng-chān-ĕt'zä	Kittatinny kīt'ā-tīn-ī
Chinquapin chĭng'kā-pīn	Klamath klā'măt
Cibola sē'bō-lä	Kodiak kōd-yăk'
Cochití kō-chĕ-tē'	Lachine lâ-shĕn'
Comanche kō-măn'chĕ	Lahontan lâ-ōn-tōn'
Conesus kō-nĕ'sūs	Laurentian lô-rĕn'shĭ-än

Luray lû-ră'	Pecos pā'kōs
Mackenzie mă-kĕn'zĭ	Planetesimal plăn'ĕt-ĕs'ĭ-măl
Madroña mă-drō'nyă	Platte plăt
Makushin mă-kōō'shĭn	Pliocene pli'ō-sĕn
Malaspina mă-lă-spĕ'nă	Pontchartrain pŏn-chăr-trăn'
Maui mă'ōō-ē	Popocatpetl pŏ-pŏ-kă-tă'pĕt'l
Mauna Kea mou'nă kă'ă	Pribilof prĕ'bĕ-lŏf'
Mauna Loa mou'nă lŏ'ă	Pueblo pwă'blŏ
Memphremagog mĕm-frĕ-mă'gŏg	Puget pŭ'jĕt
Merced mĕr-sĕd'	Rainier ră'nĕr
Mesa Verde mă'să vĕr'dĕ	Rangeley răn'jĭ
Mesabi mĕ-să'bĕ	Revilla-Gigedo ră-vĕl'yă-hĕ-hă'thŏ
Mesozoic mĕs-ŏ-zŏ'ĭk	Rio Grande rĕ'ŏ grăn'dă
Miocene mĭ'ŏ-sĕn	Roanoke rŏ-ă-nŏk'
Mohave mŏ-hă'vă	Saguenay săg-ĕ-nă'
Molokai mŏ-lŏ-kă'ĕ	St. Elias ĕ-lĭ'ăs
Monongahela mŏ-nŏng-ă-hĕ'lă	Salinas să-lĕ'năs
Montpelier mŏnt-pĕ'li-ĕr	Saluda să-lŏŏ'dă
Montreal mŏnt-rĕ-ŏl'	Samoa să-mŏ'ă
Moqui mŏ'kĕ	San Andreas săn än-drăs'
Muir mŭr	San Diego săn dĕ-ă'gŏ
Navajo năv'ă-hŏ	San Jacinto săn jă-sĭn'tŏ
Nez Percé nă pĕr-să'	San Joaquin săn hŏ-ă-kĕn'
Oahu ō-ă'hŏŏ	San Juan săn hwăn'
Oaxaca wă-hă'kă	Santa Cruz săn'tă krŏŏs
Okeechobee ō-kĕ-chŏ'bĕ	Santa Ynez săn'tă ĕ-năs'
Okefenokee ō-kĕ-fĕ-nŏ'kĕ	Sargasso săr-găs'ŏ
Olema ō-lă'mă	Saskatchewan săs-kăch'ĕ-wŏn
Oneida ō-nĭ'dă	Sault Sainte Marie sŏŏ sânt mă'rĭ
Onondaga ŏn-ŏn-dô'gă	Savaii să-vĭ'ē
Orizaba ō-rĕ-să'bă	Seminole sĕm'ĭ-nŏl
Otisco ŏt-ĭs'cŏ	Sequoia sĕ-kwoi'ă
Otsego ŏt-sĕ'gŏ	Shenandoah shĕn-ăn-dŏ'ă
Ouray ōō-ră'	Shishaldin shĭ-shăl'dĭn
Owasco ō-wăs'kŏ	Sierra Madre sĭ-ĕr'ă mă'dră
Pago păng'ŏ	Sierra Nevada sĭ-ĕr'ă nĕ-vă'dă
Palenque pă-lĕn'kă	Sioux sŏŏ
Pamlico păm'lĭ-kŏ	Skaneateles skăn-ĕ-ăt'lĕs
Papago Saguario	Spokane spŏ-kăn'
pă'pă-gŏ să-gwă'rŏ	Staunton stŏn'tŭn
Pavlof păv'lŏf	Styx stĭks

Susquehanna sŭs-kwê-hăn'ă	Tuolumne twöl'ŭm-nê
Suwannee sŏo-wô'nê	Tutuila tōo-tōo-ē'lă
Syracuse sŭr'ă-kŭs	Uncompahgre ũn-kôm-pă'grě
Tacoma tă-kô'mă	Upolu ōo'pô-lōo
Tahoe tă-hô'	Uxmal ōoz-măl'
Tallulah tăl-lōo'lă	Washoe wŏsh'ō
Taos tă'ôs	Wilkes-Barre wŭlks'băr-ŭ
Teotihuacan tē-ô-tŭ-hwă-căn'	Willoughby wŭl'ô-bŭ
Teton tē-tŏn'	Winnetoesaukee wŭn'ê-pê-sô'kê
Ticonderoga tŭ-kŏn-dêr-ô'gă	Wyandotte wŭ'ăn-dŏt
Tierra Caliente tyěr'ră că-lyěn'tê	Yosemite yô-sêm'ŭ-tê
Tierra Templada	Yucatan yōo-kă-tăn'
tyěr'ră tēm-plă'dă	Zuñi zōo'nyê
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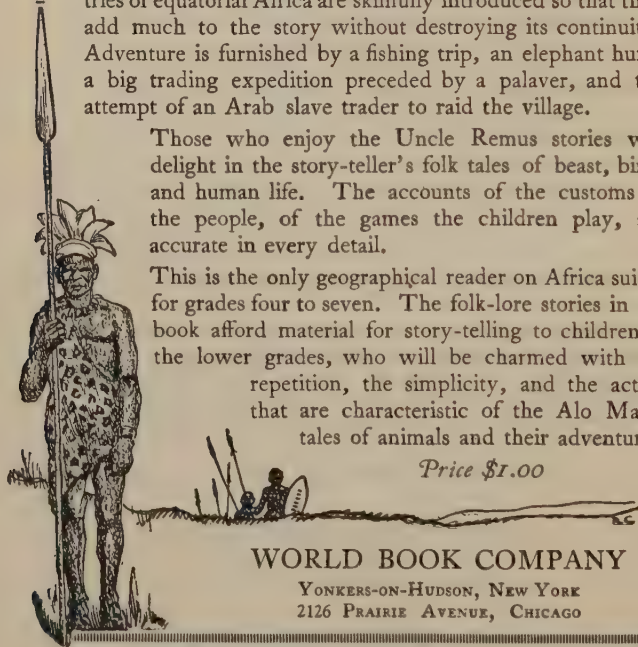
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